S
618.47
W3CFRB
1989

MONTANA STATE LIBRARY
3 0864 1002 4183 8

CLARK FORK RIVER BASIN
NUTRIENT POLLUTION SOURCE ASSESSMENT

INTERIM REPORT TO THE
SECTION 525 CLEAN WATER ACT
STUDY STEERING COMMITTEE

Prepared by:

Gary L. Ingman

Mark A. Kerr

STATE DOCUMENTS COLLECTI
DEC 23 2003
MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620

State of Montana
Department of Health and Environmental Sciences
Water Quality Bureau
Cogswell Building
Helena, Montana 59620

April 1989

DATE DUE
FEB 21 2006
GAYLORD
PRINTED IN U.S.A.

TABLE OF CONTENTS

Page

SUMMARY.. ii

1. OVERVIEW.. 1

   1.1 Introduction.. 1
   1.2 Statement of the Problem.. 1
   1.3 Monitoring Plan.. 3
   1.4 Reporting Requirements.. 4

2. METHODS.. 5

   2.1 Field Sampling.. 5
   2.2 Chemical Analysis.. 5
   2.3 Data Analysis.. 5
   2.4 Quality Assurance.. 6

3. RESULTS.. 10

   3.1 Nutrient Concentrations.. 10
   3.2 Nutrient Loads.. 10

4. DISCUSSION.. 24

5. CONCLUSIONS.. 32

6. RECOMMENDATIONS.. 37

7. LITERATURE CITED.. 38

8. ACKNOWLEDGMENTS.. 39

APPENDICES.. 40

SUMMARY

Under Section 525 of the federal Clean Water Act, the states of Montana, Idaho and Washington are conducting a three-year comprehensive water quality assessment of the Clark Fork River - Lake Pend Oreille - Pend Oreille River Basin. Montana initiated an intensive monitoring program to identify and rank the major point and nonpoint sources of nutrients to the Clark Fork River.

The monitoring network of 51 stations includes 24 mainstem stations on Silver Bow Creek and the Clark Fork River, 17 stations at the mouths of tributary streams, and 10 point source industrial and municipal discharges to the Clark Fork River. In the first six months of monitoring, samples were collected monthly and analyzed for total phosphorous, total Kjeldahl nitrogen, dissolved ammonia nitrogen, dissolved nitrate plus nitrite nitrogen, and dissolved orthophosphate. Measured nutrient concentrations and estimated cumulative nutrient loads provided the basis for the data evaluations.

Streamflows were well below normal during this monitoring period. Consequently, point source discharges would have been expected to have a relatively greater impact on nutrient concentrations and nutrient loading than nonpoint sources. The assessments presented in this report almost certainly underestimate the relative importance of nonpoint sources of nutrients in the Clark Fork Basin during more normal periods of flow.

In the first six months of monitoring, several tributaries to the upper Clark Fork and all of the wastewater discharges to the river exhibited poor water quality from the standpoint of nutrient concentrations. Total phosphorus and bioavailable nitrogen loading from the 17 tributaries was comparable to the loading from the 10 wastewater discharges. However, the discharge of bioavailable phosphorus from the wastewater sources was three-fold greater than that of the tributaries. The Missoula, Butte and Deer Lodge municipal effluents made up about 98 percent of the documented total nutrient loading from point source discharges.

Digitized by the Internet Archive
in 2014

http://archive.org/details/clarkforkriverba1989ingm

At the present time, monitoring is continuing on a twice per month basis. Following one full year of data collection, data will be reanalyzed to provide a more thorough assessment of point and nonpoint sources during a wider range of streamflow conditions, and to provide a basis for program modifications in the second year of funding.

1. OVERVIEW

1.1 Introduction

In 1987, Congress amended the federal Clean Water Act to authorize a comprehensive water quality assessment of the Clark Fork River - Lake Pend Oreille - Pend Oreille River Basin which encompasses a three-state area. Funding was appropriated under Section 525 of the Act for a three year study beginning in 1988. Montana, Idaho and Washington were each directed to conduct water quality evaluations in portions of the drainage basin within their states and a steering committee was established to coordinate the efforts.

Montana's first year allocation was $30,000. Because of a growing concern over nutrient pollution in the basin and limitations in the available data, a plan was developed to monitor for, identify and rank the major point and nonpoint sources of nutrients to the Clark Fork River in Montana.

This report describes Montana's Clark Fork Basin nutrient monitoring program and presents the results of the first half year of effort.

1.2 Statement of the Problem

Nutrients are natural components of every aquatic ecosystem. The inherent fertility of a stream, measured as the concentration of nitrogen, phosphorus and other nutrients, is an important factor in fish production and often controls the amounts of algae a river or lake produces. When a waterbody becomes overloaded with nutrients, from natural or cultural sources, nuisance growths of algae often result. In extreme cases, large concentrations of attached or suspended algae can deplete the oxygen dissolved in the water and favor the propagation of rough fish over game fish. The term for this phenomenon is eutrophication.

Of the many nutrients required by algae and other aquatic plants, nitrogen and phosphorus are the two elements usually in the shortest supply in natural waters relative to the

needs of the plant. As a result, the growth of algae is often controlled by the concentration of nitrogen or phosphorus, or both, in the water column. Only the soluble inorganic forms of these two nutrients -- nitrate, nitrite and ammonia nitrogen and orthophosphate -- are readily available for plant uptake. The sum of the soluble inorganic nitrogen fractions is called total soluble inorganic nitrogen or TSIN. Soluble orthophosphate is frequently referred to as soluble reactive phosphorus, or SRP.

The upper and middle reaches of the Clark Fork are some of the most productive stream waters in Montana west of the Continental Divide from the standpoint of nutrient concentrations and the potential to grow algae. The upper Clark Fork, from its headwaters to the Blackfoot River, supports excessive growths of _Cladophora_, a filamentous green algae, and diatom algae. Aesthetics problems result, recreational potential is reduced and dissolved oxygen concentrations occasionally fall below acceptable levels as a result of algal respiration. Other beneficial water uses, such as irrigation, are likely impaired as well because large amounts of sloughing _Cladophora_ are capable of plugging pump intakes and headgates. From the Blackfoot River to the Flathead River, the Clark Fork supports heavy growths of diatom algae and localized developments of _Cladophora_. While the algae problem in this reach is not as severe, it probably contributes to depressed summer dissolved oxygen concentrations, and reduced aesthetics. (MDHES, 1988a; Ingman, 1988; Johnson and Schmidt 1988).

The primary nutrient-related concern in the lower Clark Fork, below the Flathead River, relates to the influence of nutrient loading rates to Idaho's Lake Pend Oreille. The Clark Fork provides greater than 90 percent of lake's inflow. While nutrient concentrations in the lower Clark Fork are consistently low and would not be expected to support nuisance developments of algae, total nutrient loading to the lake may be relatively high. A perceived change in the trophic status of the lake in recent years and increased proliferation of lake algae have given cause for concern. (MDHES, 1985).

1.3 Monitoring Plan

The Montana Water Quality Bureau has been conducting a basin-wide, fixed-station water quality monitoring program in the Clark Fork River Basin since 1985. The objective of that program is to 1) detect violations of ambient water quality standards, 2) provide data for water quality management decisions, 3) monitor the biological health of the river and 4) assess long-term trends in water quality as a result of resource development activities and reclamation and pollution control efforts. In 1987, Congress, through amendments to the Clean Water Act (CWA), authorized a comprehensive water quality assessment of the entire Clark Fork River-Lake Pend Oreille-Pend Oreille River Basin. Funding was appropriated for a three year, three state study and in 1988, Montana received a $30,000 grant to initiate their portion of the project. The objective of the first year effort as identified in the plan of study (MDHES, 1988b) was to:

- Measure flows and nutrient concentrations of all major point source wastewater discharges to the Montana portion of the Clark Fork River
- Estimate nutrient loadings for all major point source discharges
- Measure streamflows and nutrient concentrations of a number of representative tributaries to the Montana portion of the Clark Fork River
- Estimate nutrient loadings for representative tributaries
- Identify tributaries and reaches of the mainstem Clark Fork River which appear to contain important nonpoint sources of nutrient loading
- Develop a basin-wide nutrient budget for the Clark Fork River in Montana and provide a ranking of documented or apparent point and nonpoint sources of nutrients.

Beginning in July 1988, Montana's core monitoring network of 32 Clark Fork Basin monitoring stations was expanded to 51 stations

(Table 1). The resulting monitoring network consists of 24 mainstem Clark Fork River monitoring stations, 17 tributaries and 10 wastewater discharges to the river, and covers the reach from Butte, Montana to below Cabinet Gorge Dam in Idaho.

The 10 wastewater discharges include all but six of the municipal discharges in the basin (Anaconda, Phillipsburg, Lolo, Stevensville, Hamilton, and Plains). However, neither Anaconda or Plains have direct discharges to the Clark Fork or its tributaries. The four remaining municipalities discharges to Flint Creek and the Bitterroot River, which are included in the monitoring network. The Stone Container Corporation and Anaconda Minerals Company Warm Springs Pond discharges are the only permitted industrial discharges in the network. While several others exist, in general they are not suspected to be important nutrient sources and/or their receiving streams are included in the current network.

The 17 tributary stations were selected on the basis of size, the suspected or known presence of significant nutrient sources within the basin and the presence of active U.S. Geological Survey streamflow gaging stations (MDHES, 1988b).

1.4 Reporting Requirements

The CWA study steering committee has established an annual April due date for the preparation of interim study progress reports. The intent of the reports is to provide a review and summarization of findings to date which will help to guide the direction of the ongoing three year study of the Clark Fork-Pend Oreille Basin. This report is intended to fulfill that need.

2. METHODS

2.1 Field Sampling

Unfiltered grab samples were collected at each of the 51 monitoring stations (Table 1) at a frequency of once per month from July through December. Subsamples for dissolved nutrient analysis were field-filtered through a glass fiber prefilter and a 0.45 µm membrane filter. Samples were stored on ice and hand-carried or bussed to the laboratory for analysis within 48 hours of collection. All sample collection, handling, preservation and storage procedures followed EPA-approved methods described in the study plan (MDHES, 1988b).

Discharge rates for effluents were measured at the time of sample collection with the primary flow measuring device located at each outfall (weir or flume). Mainstem and tributary streamflows were gaged with standard streamflow gaging equipment at the time of sample collection, except for those locations where USGS gaging stations were present. Relevant field observations were routinely recorded at all monitoring locations.

2.2 Chemical Analysis

Nutrient samples from all monitoring locations were analyzed by the Montana Department of Health Chemistry Laboratory Bureau within approved holding times. Parameters analyzed on all samples except for the Stone Container Corporation wastewater included dissolved orthophosphate (SRP), dissolved nitrate plus nitrite nitrogen, dissolved ammonia nitrogen, total phosphorus and total Kjeldahl nitrogen. The Stone Container wastewater proved to be nonfilterable in the field and was analyzed for total forms of the same nutrients. 2Analytical methods and detection limits are summarized in the study plan (MDHES, 1988b).

2.3 Data Analysis

Upon receipt of the analytical reports from the

laboratory, all data were hand-tabulated and visually inspected for possible errors. Monthly mean discharge rates for effluents were obtained from self-monitoring reports submitted by dischargers, where flow measurement frequencies were greater than our once per month monitoring frequency. Provisional daily and monthly average streamflow data were obtained from the U.S. Geological Survey for Clark Fork Basin gaging stations. Flows for the Clark Fork below Thompson Falls Dam were obtained from the Montana Power Company. All data for the six-month period were then entered onto a computer spreadsheet and reviewed for transcription errors. Statistical summaries of nutrient concentrations and streamflows were generated and total nutrient loads estimated by the computer program. Graphic presentations of the data were prepared.

2.4 Quality Assurance

A number of procedures were followed in the laboratory and in the field to insure the integrity of nutrient data. All apparatus used in collecting and filtering samples for dissolved nutrients was cleaned thoroughly before each reuse. Collection bottles, sample bottles, filter holders, and syringes were soaked for a minimum of several hours in a solution of 25 percent HCl to remove trace concentrations of nitrogen and phosphorous. All apparatus was then rinsed thoroughly with distilled/deionized water.

Field procedures were followed to further minimize the possibility of sample contamination and to document the integrity of the data. Bottles for collecting samples for analysis of total phosphorous and total Kjeldahl nitrogen were rinsed three times with ambient water, as were collection bottles for dissolved nutrients. Filters were purged once with a 50 ml aliquot of sample, then again with another 50 ml aliquot which was used to rinse sample bottles. Two filter blanks were collected during each sampling episode by collecting, filtering and preserving a quantity of distilled/deionized water following

the procedures used for ambient samples. This documented the thoroughness of cleaning techniques and the amount of contamination introduced by sample handling and preservation. Once a quarter, field-originated duplicate and spiked samples were submitted to the laboratory to validate that the accuracy and precision limits of laboratory data were not violated by the combined effects of field sampling procedures and laboratory analytical methods.

The laboratory maintains a strict quality assurance/quality control program which ensures that all generated data were of known quality (precision and accuracy). This program involves the extensive use of duplicates, spikes, known standards, and EPA audit samples. (MDHES, 1974).

Table 1. Fiscal Year 1989 Clark Fork Basin Nutrient Monitoring Stations

Station Number	Station Name
I. Mainstem Stations	
00	Silver Bow Creek above Butte WWTP
01	Silver Bow Creek below Colorado Tailings
02	Silver Bow Creek at Miles Crossing near Ramsay
03	Silver Bow Creek at frontage road above Warm Springs Ponds
04	Discharge from AMC Pond 2 (Silver Bow Creek)
07	Clark Fork below Warm Springs Creek
08	Clark Fork near Dempsey
09	Clark Fork at Deer Lodge
10	Clark Fork above Little Blackfoot River
11	Clark Fork at Gold Creek Bridge
12	Clark Fork at Bonita
13	Clark Fork at Turah
15	Clark Fork below Milltown Dam
16	Clark Fork above Missoula WWTP
18	Clark Fork at Shuffield's
20	Clark Fork at Harper Bridge
22	Clark Fork at Huson
23	Clark Fork near Alberton
24	Clark Fork at Superior
25	Clark Fork above Flathead River
27	Clark Fork above Thompson Falls Reservoir
28	Clark Fork below Thompson Falls Dam
29	Clark Fork at Noxon Bridge
30	Clark Fork below Cabinet Gorge Dam
II. Tributaries	
05	Mill-Willow Bypass at mouth
06	Warm Springs Creek near mouth
07.3	Lost Creek near mouth
08.3	Racetrack Creek near mouth
08.7	Dempsey Creek near mouth
09.3	Cottonwood Creek near mouth
10.2	Little Blackfoot River at USGS station near mouth
10.5	Warm Springs Creek (near Phosphate) near mouth
10.7	Gold Creek near mouth
11.5	Flint Creek near mouth
12.5	Rock Creek at USGS station near mouth
14	Blackfoot River at USGS Station near mouth
18.5	Bitterroot River at HW93 crossing
19	Bitterroot River near mouth
26	Flathead River near mouth
27.5	Thompson River at USGS station near mouth
27.7	Prospect Creek at USGS station near mouth

Table 1. Continued

Station Number	Station Name
III. Point Source Discharges	
00.5	Butte Metro WWTP discharge
06.5	Warm Springs lagoon discharge
07.7	Galen WWTP discharge
09.5	Deer Lodge lagoon discharge
11.6	Drummond lagoon discharge
17	Missoula WWTP discharge
21	Stone Container Corporation wastewater discharge
23.5	Alberton lagoon discharge
24.5	Superior lagoon discharge
27.6	Thompson Falls lagoon discharge

3. RESULTS

3.1 Nutrient Concentrations

Measured concentration ranges and mean values for dissolved orthophosphate (soluble reactive phosphorus or SRP), total phosphorus (Total P) and total soluble inorganic nitrogen (TSIN or nitrate plus nitrite plus ammonia nitrogen) for each monitoring station for the period July through December 1988 are presented in Table 2. The reader is referred to Table 1 for a description of the monitoring stations associated with each station number. A key to the monitoring stations has also been inserted loose inside the front cover of the report. Individual monitoring data for the period are included in the appendices.

Graphs of mean phosphorus and nitrogen concentrations at mainstem Clark Fork monitoring locations are given in Figure 1 and 2. Mean nutrient concentrations for tributary monitoring stations are presented in Figures 3 and 4. The same data for the monitored wastewater discharges appear in Figures 5 and 6.

3.2 Nutrient Loads

Estimated cumulative discharges (or loads) of SRP, Total P and TSIN for each monitoring station over the six month monitoring period are presented in Table 3.

Graphic presentations of cumulative P and N loads for Silver Bow Creek and mainstem Clark Fork monitoring stations appear in Figures 7 and 8. Cumulative P and N loads for the tributary stations and wastewater discharges are given in Figures 9-10 and 11-12, respectively.

The stacked bar graphs in Figures 13-15 give estimated cumulative P and N loads for tributaries and wastewater discharges "stacked" on top of estimated cumulative loads for mainstem stations located above their point of discharge to the mainstem river. The intent is to show how instream mainstem nutrient loads would be expected to increase if all the nutrients discharged by a tributary or effluent were detectable at the next downstream mainstem monitoring station. It is also a useful tool

to detect other nutrient sources (or sinks) when downstream increases in nutrient loads cannot be explained by monitored incoming tributaries or effluents. Lastly, it can be used as an estimate of the accuracy of the load estimates presented because, in the absence of significant sources or sinks, nutrient loads would be expected to be additive progressing downstream.

Table 2. Fiscal Year 1989 Clark Fork Basin Nutrient Concentration Data Summary

		Measured Concentration (µg/l) July Through December 1988					
Station		SRP		Total P		TSIN	
Number	N=	Conc. Range	Mean	Conc. Range	Mean	Conc. Range	Mean
I. Mainstem Stations							
00	6	9- 21	14	58- 111	88	1640-2000	1830
01	6	919-1180	1021	1230-1890	1485	3680-5670	4515
02	6	300- 597	411	610- 920	806	2180-3830	3298
03	6	123- 284	182	330- 998	548	980-2750	1975
04	6	9- 137	61	40- 167	96	<10- 550	132
07	6	3- 70	30	21- 112	56	60- 330	145
08	6	6- 18	12	24- 48	35	10- 340	128
09	6	4- 9	6	12- 69	32	80- 400	253
10	6	17- 92	45	55- 116	86	<10- 450	138
11	6	11- 84	34	38- 104	66	<10- 320	92
12	6	6- 32	13	18- 67	41	<10- 120	20
13	6	3- 9	7	15- 34	22	10- 60	23
15	6	3- 8	6	13- 35	20	<10- 50	18
16	6	2- 7	4	15- 35	20	<10- 30	12
18	6	36- 96	57	55- 106	74	80- 160	128
20	6	10- 19	14	25- 50	35	50- 120	83
22	6	10- 20	15	31- 108	47	<10- 100	48
23	6	11- 17	13	27- 46	34	<10- 70	27
24	6	6- 9	7	15- 26	21	<10- 80	37
25	6	2- 7	5	12- 19	15	<10- 30	17
27	6	1- 2	2	7- 10	9	<10- 40	10
28	6	1- 3	2	7- 11	10	<10- 10	<10
29	6	1- 7	4	8- 16	12	<10- 50	28
30	6	1- 5	2	7- 13	10	<10- 30	18
II. Tributaries							
05	6	5- 21	10	24- 43	33	100- 270	168
06	6	2- 16	9	8- 14	11	20- 110	73
07.3	6	4- 11	7	7- 27	16	<10- 480	233
08.3	6	5- 17	9	11- 30	18	120- 360	250
08.7	6	28- 33	30	35- 58	42	260- 780	580
09.3	6	10- 80	26	19- 102	39	<10- 10	<10
10.2	6	13- 23	19	25- 38	30	<10- 10	<10
10.5	6	5- 21	11	17- 31	21	<10- 220	62
10.7	6	83- 144	119	106- 223	153	10- 70	28
11.5	6	20- 69	43	46- 92	63	<10- 90	32
12.5	6	3- 8	5	9- 25	13	<10- 20	<10
14	6	1- 4	2	5- 14	8	<10- 440	78
18.5	6	2- 14	6	13- 24	17	30- 90	57
19	6	2- 6	4	11- 29	18	50- 100	67
26	6	1- 3	2	4- 10	7	<10- 30	12
27.5	6	3- 5	4	5- 16	10	<10- 30	15
27.7	6	3- 10	6	4- 14	9	<10- 50	22

Table 2. Continued.

Station		Measured Concentration (µg/l) July Through December 1988					
		SRP		Total P		TSIN	
Number	N=	Conc. Range	Mean	Conc. Range	Mean	Conc. Range	Mean
III. Point Source Discharges							
00.5	6	2860-3990	3418	3190-4470	3658	6810-11740	9455
06.5	6	52- 345	153	93- 326	215	140- 2250	757
07.7	6	1290-4280	3073	1470-4500	3372	2580-11500	7045
09.5	6	1340-2530	2058	1530-5250	2787	2120- 7380	4840
11.6	6	275-1110	743	302-7870	2065	50- 3630	1447
17	6	4690-5300	4920	4430-5390	4958	10110-16220	12423
21[a]	2	181- 566	374	368- 510	439	1270- 1280	1275
23.5	6	4060-6210	5087	5110-6850	5950	5040-19540	12613
24.5	6	5560-6880	6123	6110-9620	7215	12610-20500	16908
27.6	6	313-4220	2161	1710-4650	3158	10- 6510	1970

---

[a] Concentration data given are all totals. Stone wastewater is not filterable.

Table 3. Fiscal Year 1989 Clark Fork Basin Nutrient Load Data Summary

Station	Estimated Total Discharge (tons) July Through December 1988		
Number	SRP	Total P	TSIN
I. Mainstem Stations			
00	0.05	0.34	6.91
01	8.58	12.37	38.10
02[a]	3.73	7.55	31.87
03	2.58	7.92	28.00
04	0.36	0.61	1.12
07	0.41	0.85	2.70
08	0.20	0.87	5.18
09	0.29	2.11	14.25
10	1.42	4.12	11.35
11	2.35	5.66	11.14
12	1.94	7.01	4.75
13	1.80	6.21	7.06
15	2.71	10.48	10.79
16	2.12	10.22	6.03
18	25.46	34.56	61.24
20	11.90	29.20	74.77
22	13.07	42.67	48.76
23	11.08	28.34	28.24
24	6.20	17.68	30.49
25	5.37	16.74	20.20
27	6.93	41.15	45.93
28	7.70	46.56	18.95
29	13.57	48.69	105.29
30	10.25	53.65	91.74
II. Tributaries			
05	0.06	0.20	1.11
06	0.02	0.05	0.38
07.3	0.04	0.12	3.71
08.3	0.01	0.03	0.31
08.7	0.04	0.07	0.66
09.3	0.03	0.04	0.00
10.2	0.34	0.57	0.04
10.5	0.01	0.03	0.11
10.7	0.67	0.90	0.19
11.5	0.73	1.32	1.14
12.5	0.44	0.93	0.56
14	0.33	1.90	24.30
18.5	1.60	5.45	18.77
19	1.26	6.13	22.60
26	5.86	28.17	50.78
27.5	0.28	0.67	1.00
27.7	0.14	0.25	0.68

Table 3. Continued.

Station Number	Estimated Total Discharge (tons) July Through December 1988		
	SRP	Total P	TSIN
III. Point Source Discharges			
00.5	13.40	14.19	36.44
06.5	0.01	0.02	0.13
07.7	0.16	0.18	0.37
09.5	1.94	2.57	4.25
11.6	0.06	0.21	0.13
17	22.13	22.25	55.54
21[b]	0.06	0.08	0.27
23.5	0.07	0.08	0.20
24.5	0.35	0.41	0.95
27.6	0.11	0.16	0.12

---

[a] Nutrient loads for station 02 can be presumed to be under-estimated. Gaged streamflows did not include a side channel to the creek.

[b] Most wastewater from the Stone Container Corporation mill is discharged in March through June. First half FY89 loads are not representative of the entire year.

FIGURE 1

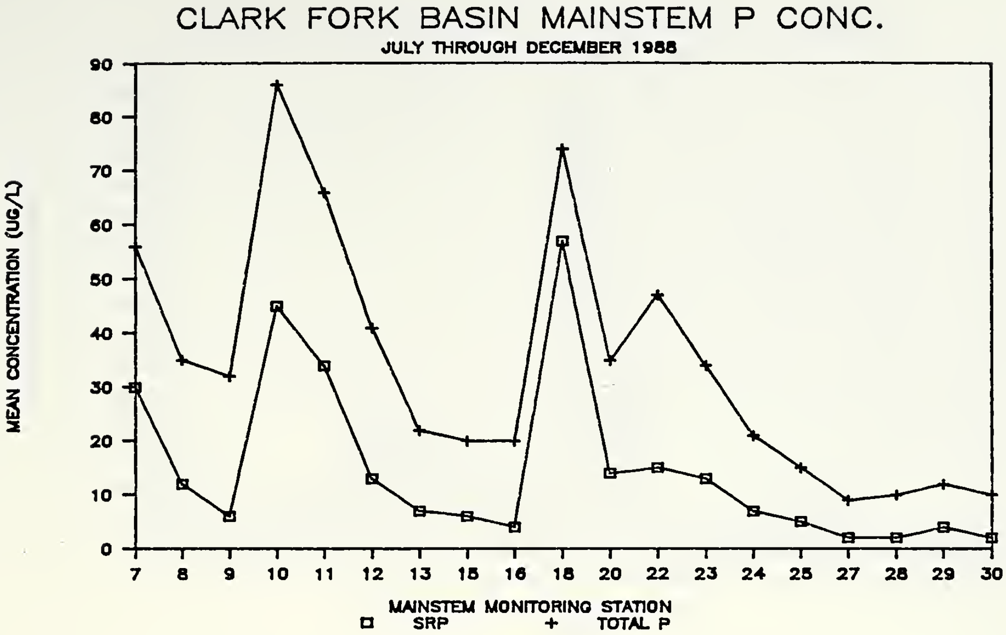


FIGURE 2

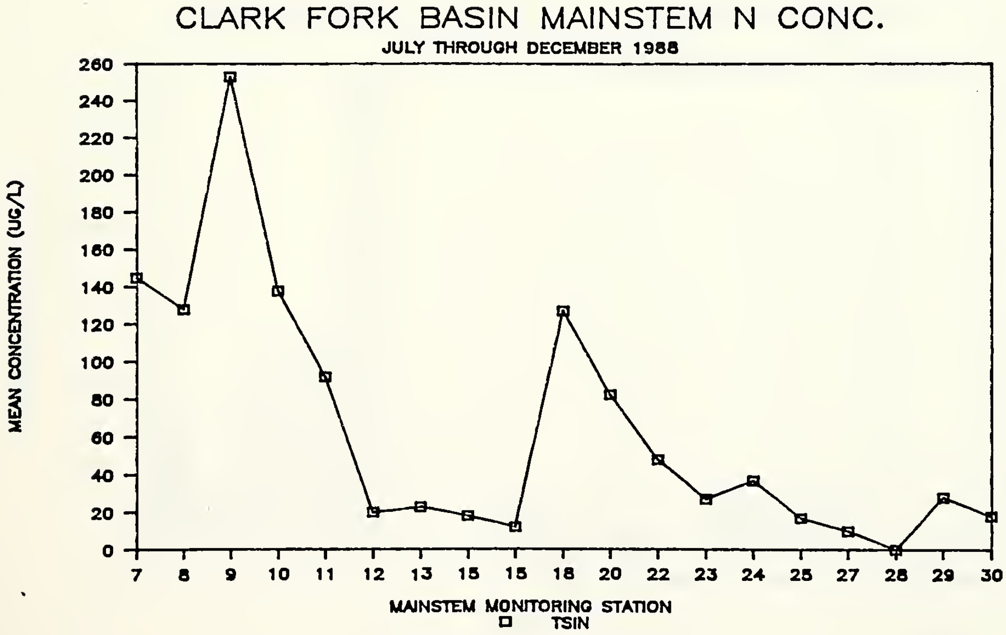


FIGURE 3

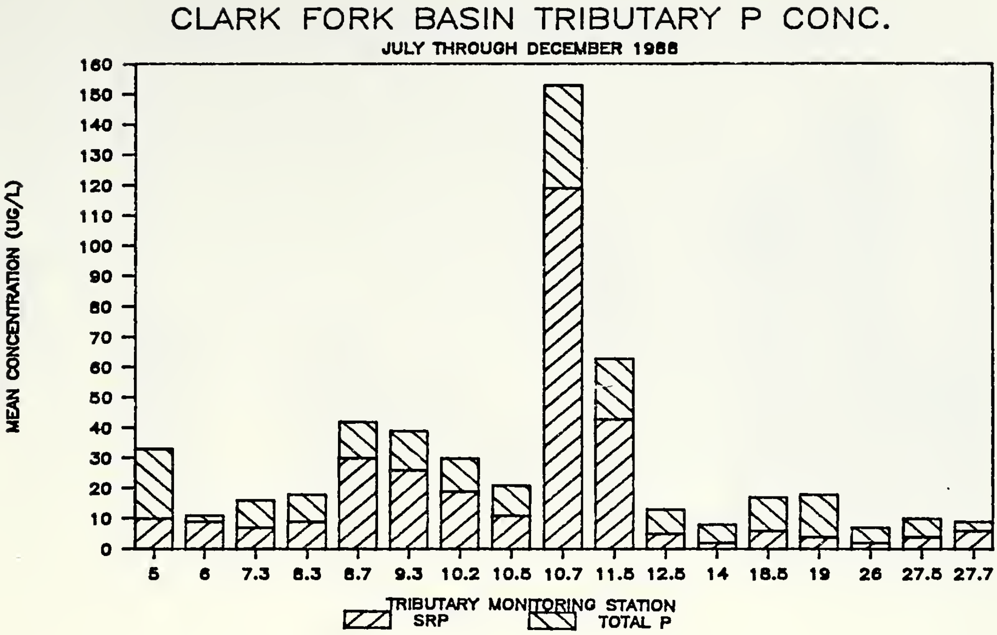


FIGURE 4

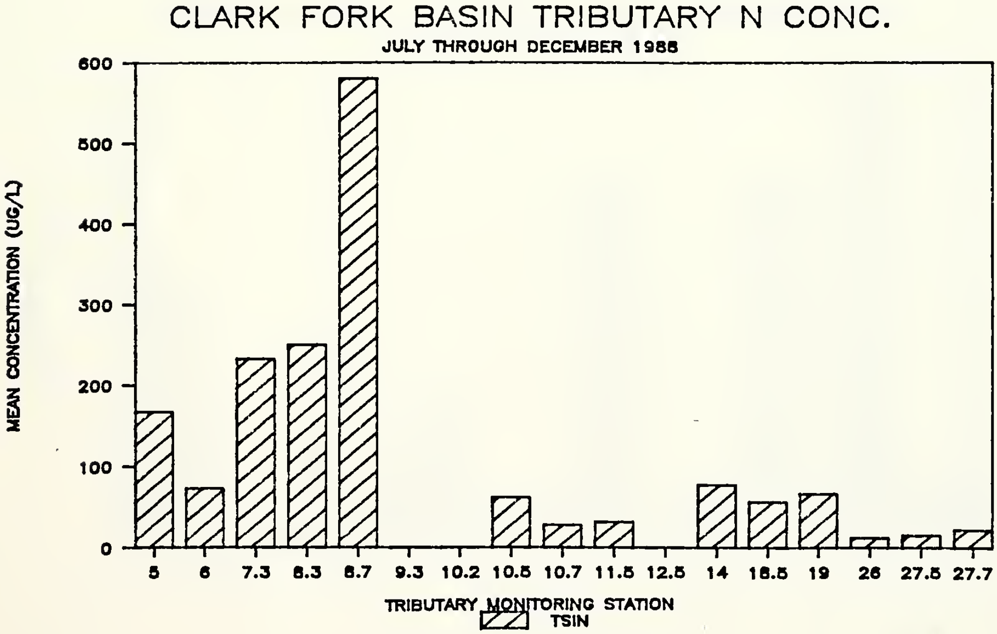


FIGURE 5

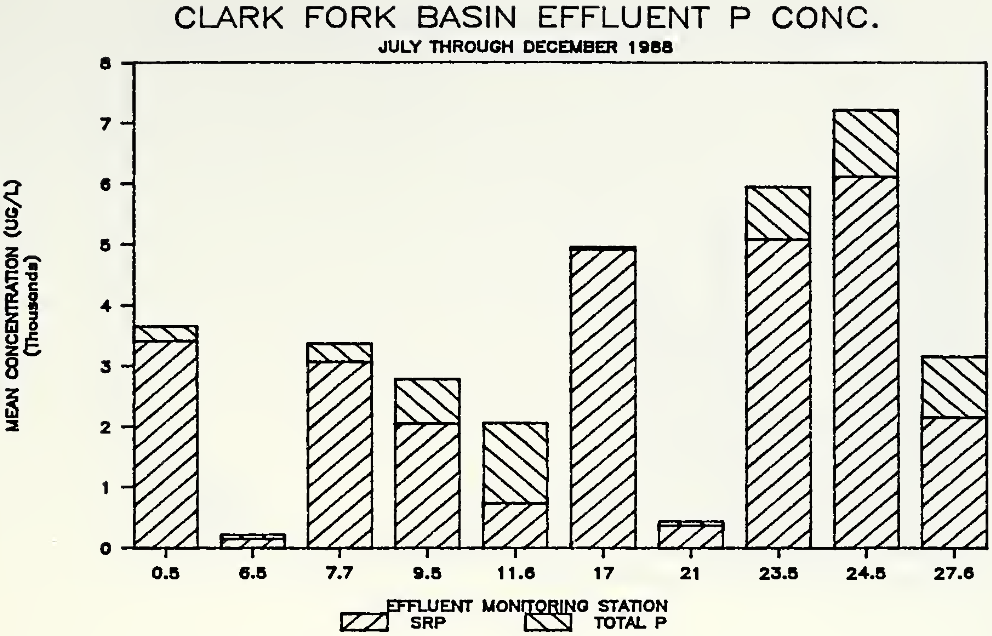


FIGURE 6

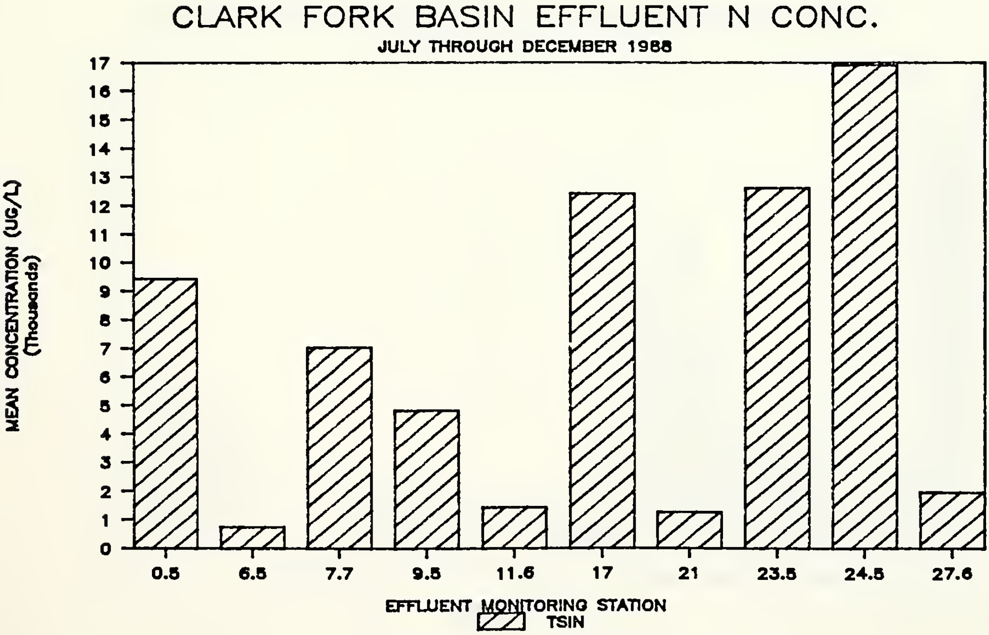


FIGURE 7

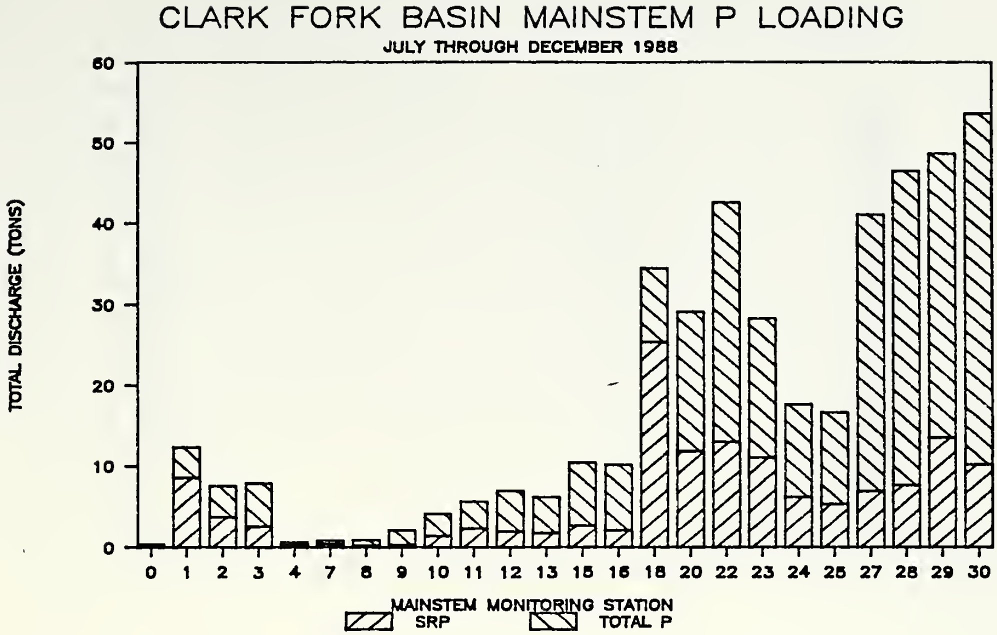


FIGURE 8

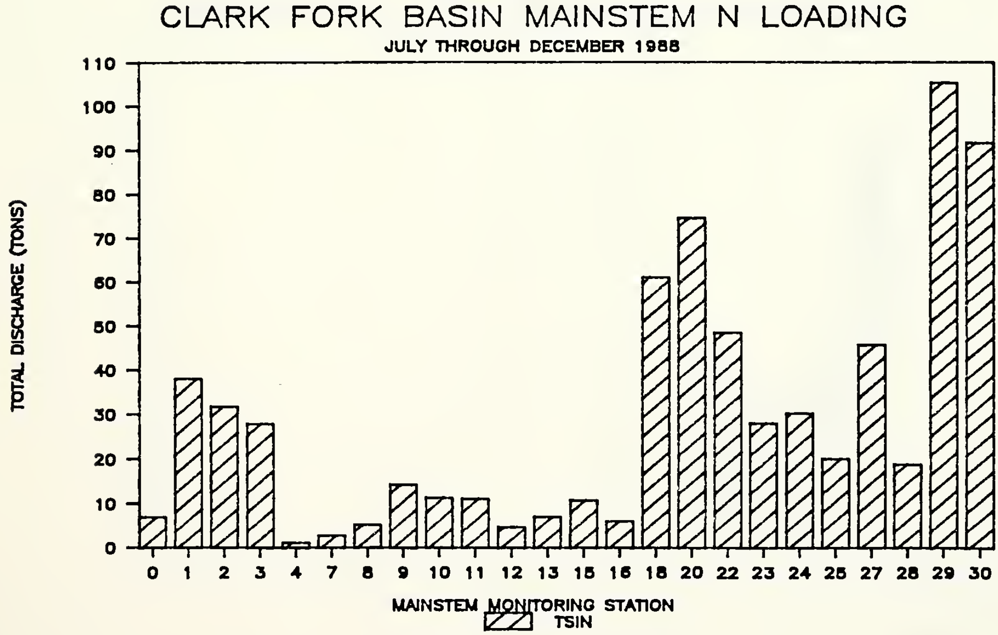


FIGURE 9

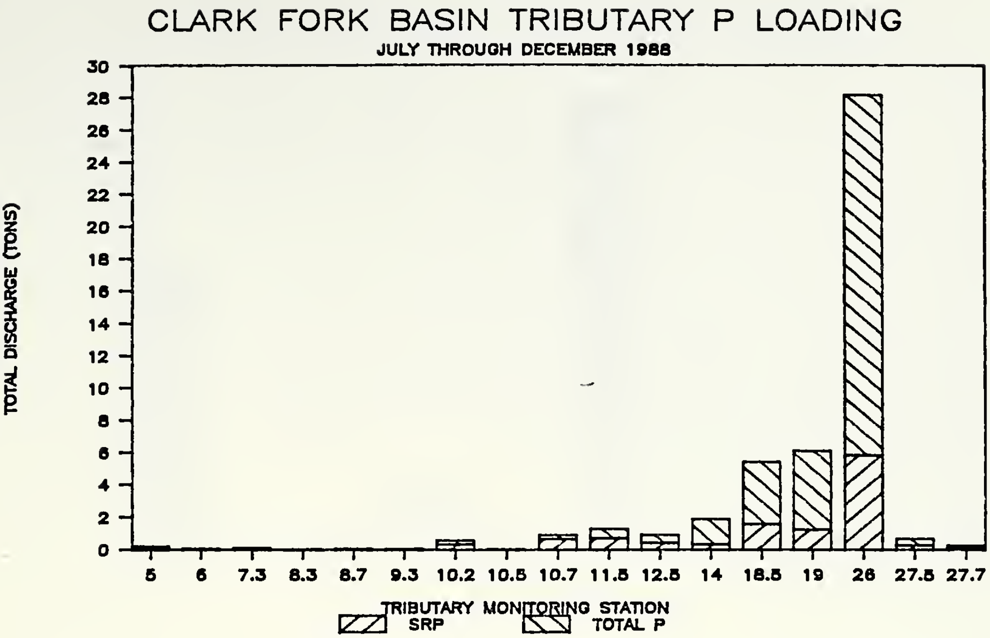


FIGURE 10

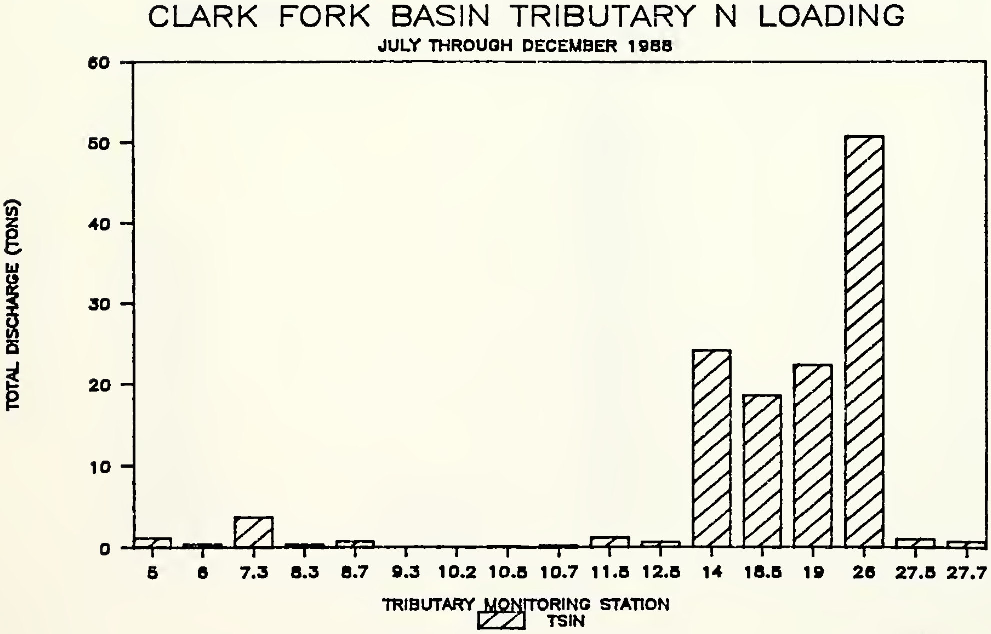


FIGURE 11

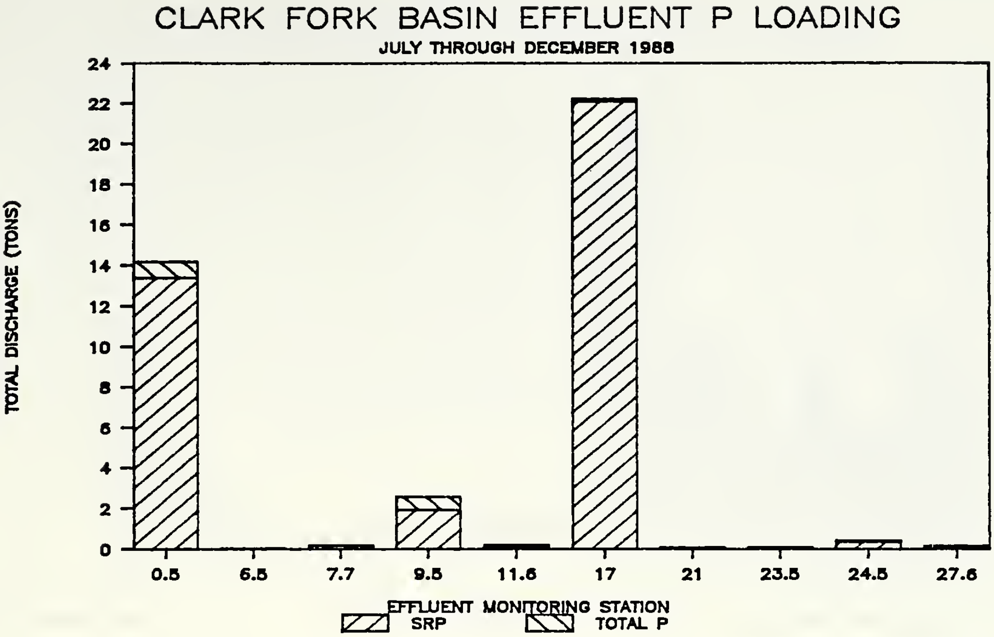


FIGURE 12

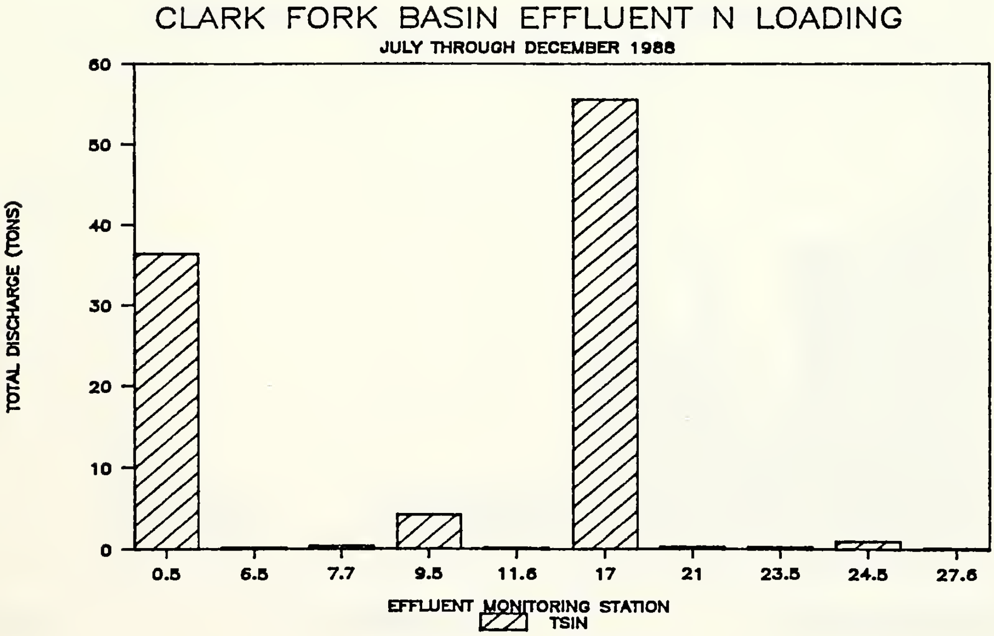
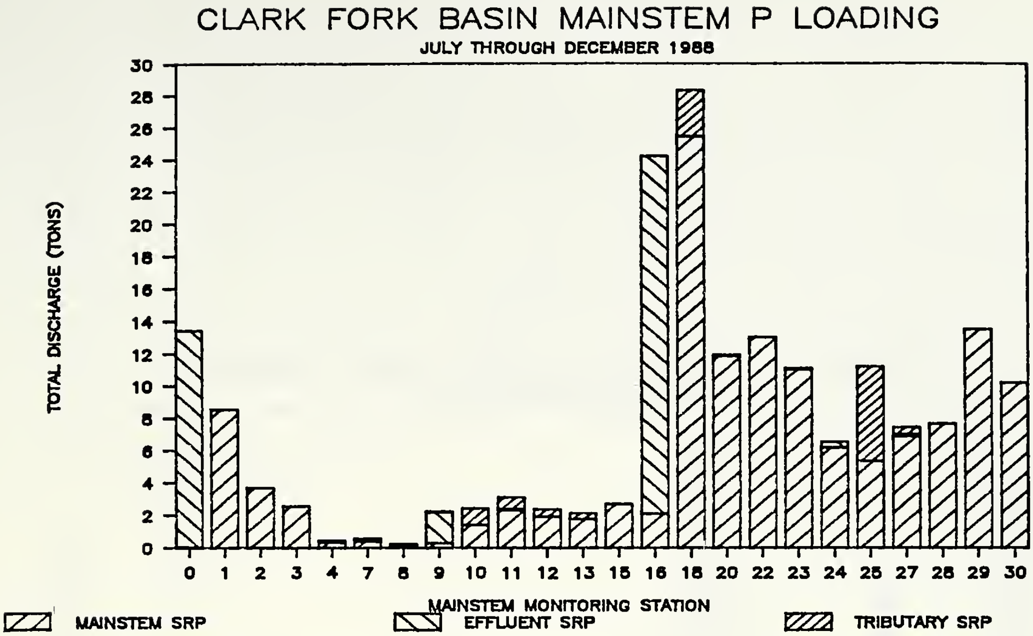


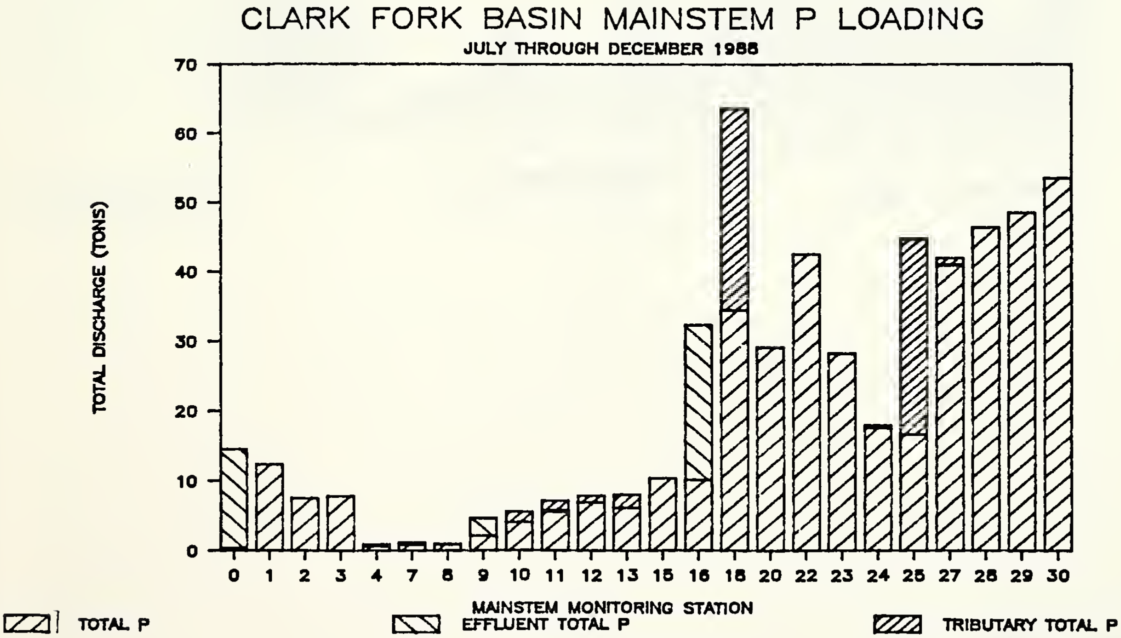
FIGURE 13



CLARK FORK BASIN MAINSTEM P LOADING

JULY THROUGH DECEMBER 1988

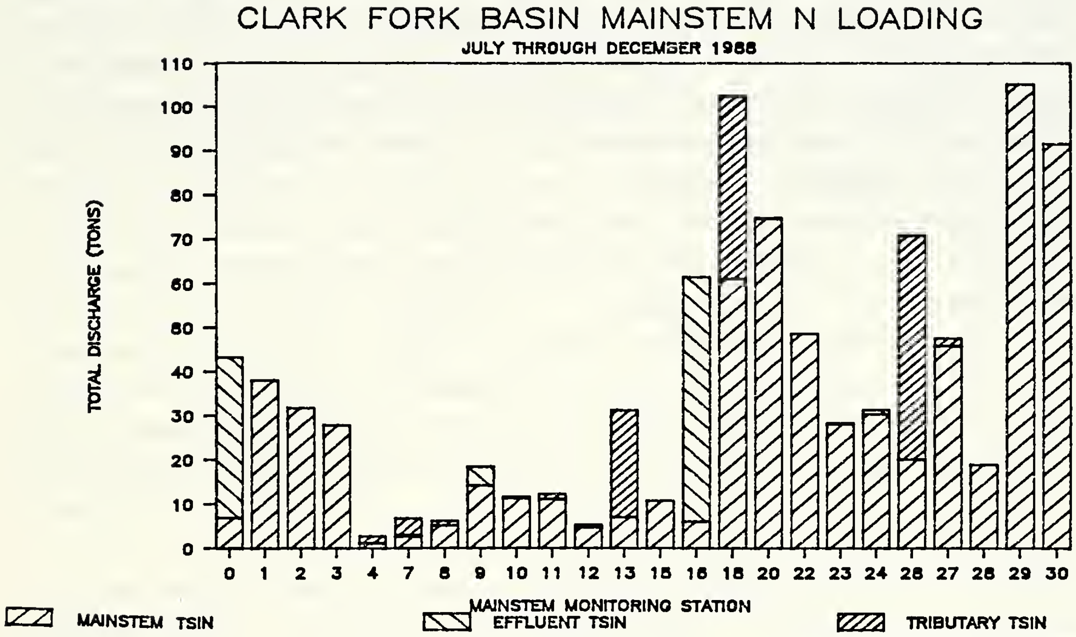
FIGURE 14



CLARK FORK BASIN MAINSTEM P LOADING

JULY THROUGH DECEMBER 1988

FIGURE 15

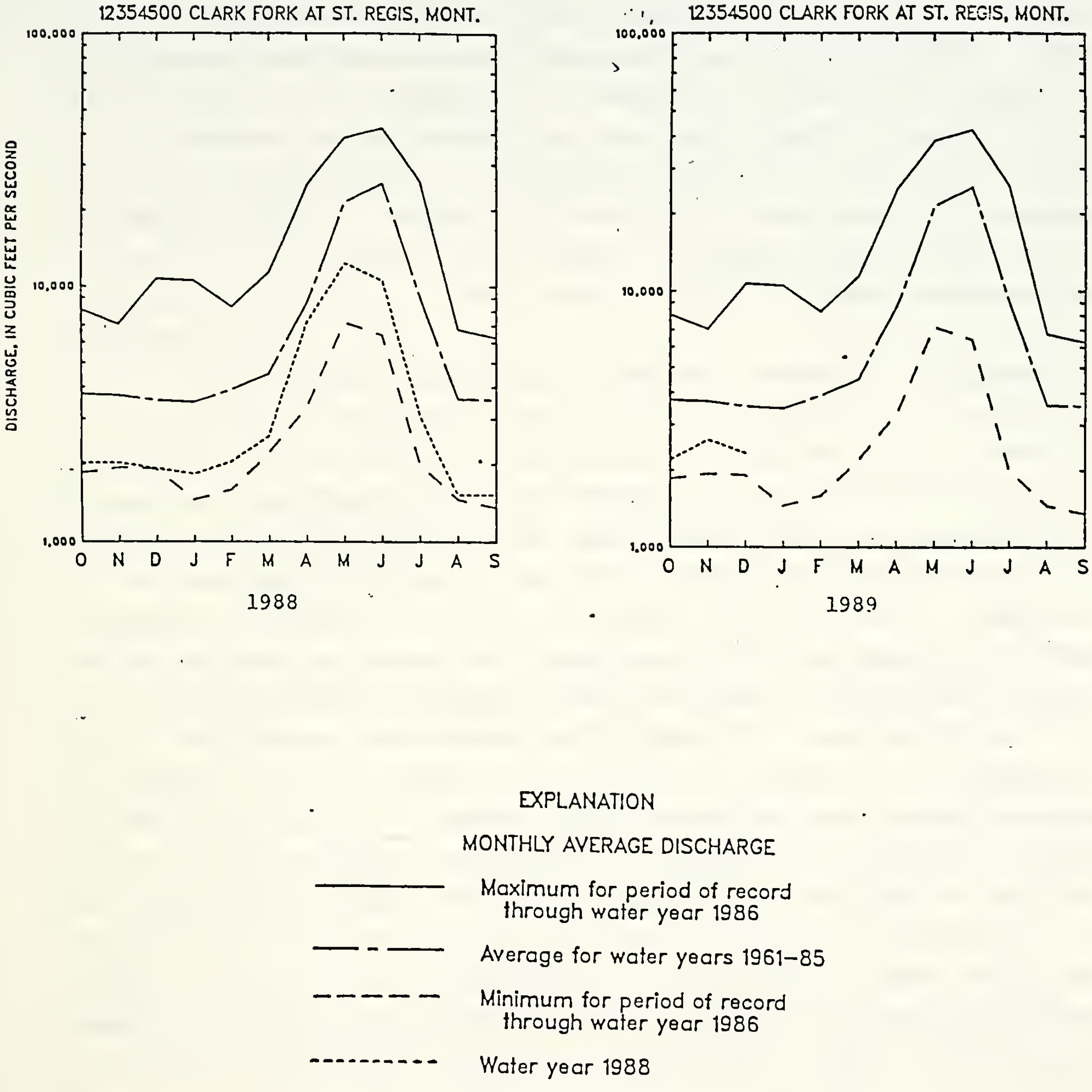

CLARK FORK BASIN MAINSTEM N LOADING
JULY THROUGH DECEMBER 1988
TOTAL DISCHARGE (TONS)
110
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
7
8
9
10
11
12
13
15
16
18
20
22
23
24
26
27
28
29
30
MAINSTEM MONITORING STATION
MAINSTEM TSIN
EFFLUENT TSIN
TRIBUTARY TSIN

4. DISCUSSION

Streamflows in the Clark Fork Basin were well below normal during the monitoring period (Figure 16) due to the cumulative effects of several years of drought. During low streamflow conditions, point source discharges (municipal and industrial effluents) can be expected to have a relatively greater impact on nutrient concentrations and contribute a larger share of the total nutrient loading in a receiving stream when compared to other sources of nutrients. This is because many wastewater discharges have relatively constant discharge rates and low streamflows result in a decreased volume of river water which is available to dilute the wastewater. Nonpoint sources of nutrients become less significant because the same factors which influence streamflows (precipitation and runoff) also influence nonpoint pollution sources. Consequently, the assessments presented in this report almost certainly underestimate the relative importance of nonpoint sources of nutrients in the Clark Fork Basin. At the same time, the impacts of point source discharges as presented probably constitute a near worst-case scenario.

The discussion that follows reviews measured nutrient concentrations and estimated nutrient loads for the 51 mainstem Clark Fork, tributary and wastewater discharge monitoring stations. The U.S. EPA has established concentration criteria values for total inorganic nitrogen and total phosphorus that should not be exceeded in order to prevent excessive developments of attached algae in rivers and to prevent eutrophication in lakes which are fed by rivers. The values are 1000 µg/l for nitrogen (water quality criteria matrix *in* MDHES, 1986) and 50 µg/l for phosphorus (U.S. EPA, 1986). While the criteria may not apply equally well in all situations and do not consider other limitations to algal growth, they are valuable as a general benchmark against which measured instream nutrient concentrations can be compared. The criteria do not apply to wastewater discharges and these must be compared to one another to assess

Figure 16. Water Year 1988 and 1989 (partial) hydrographs for Clark Fork at St. Regis.



Source: U. S. Geological Survey Montana streamflow reports, October 1988 and January 1989.

their relative qualities, keeping in mind that effluent qualities will vary as a function of the different types of treatment systems employed at each location (e.g., lagoon versus conventional secondary treatment).

Nutrient loads provide a measure of the total weights of nitrogen and phosphorus discharged per unit of time. These data allowed us to compare and develop a numerical ranking of point sources of nutrients in the basin and to examine the relative importance of nonpoint nutrient sources. This information will be especially useful to water quality managers if it is determined that nutrient loading rates need to be reduced to protect Lake Pend Oreille from accelerated eutrophication.

The Clark Fork River mainstem nutrient concentration data plotted in Figures 1 and 2 show a distinct trend. In general, river nutrient concentrations declined with increasing distances from point source discharges. An initial decline in nutrient concentrations in the upper Clark Fork was attributable to increasing distance from the Butte WWTP discharge and increased dilution from incoming tributaries. Nutrient concentrations in Silver Bow Creek, which is the receiving stream for the Butte WWTP discharge, were an order of magnitude higher than Clark Fork concentrations (Table 2) and could not be included on the graphs. Notable spikes in phosphorus concentration and the highest mean concentrations found anywhere in the river occurred immediately downstream of the Deer Lodge and Missoula municipal WWTP discharges, at stations 10 and 18, respectively. Highest mean concentrations of nitrogen were present at several locations in the upper Clark Fork and immediately below the Missoula WWTP. Lowest mean concentrations of P and N occurred in the lower Clark Fork, below the Flathead River.

A rather large average increase in total phosphorus concentration was noted from monitoring station 20 (Clark Fork at Harper Bridge) to station 22 (Clark Fork at Huson). However a

proportionate increase in SRP was not observed. These monitoring stations bracket the Stone Container Corporation kraft mill. While the Stone wastewater contains relatively high concentrations of phosphorus, only a small volume of wastewater was discharged during the monitoring period. Mass balance calculations indicate that the observed increase cannot be accounted directly for by the wastewater discharge. A possible explanation is that significant quantities of sloughing algae present in the water column at the downstream station during fall and winter months contributed to the higher measurements. It is reasonable to assume that nutrient discharges from the Stone facility earlier in the year (i.e. during the spring months when most effluent is released) promoted the development of instream algal accumulations which then began to slough during the cooler temperatures and shorter days of the fall months. The individual monitoring data included in Appendix A. indicate that the most significant downstream increase in phosphorus occurred during the month of December.

Another contributing factor might be the presence of significant nonpoint sources of phosphorus, probably associated with sediment inputs, in this reach of the river. It is known that streambanks are unstable and prone to erosion in the area above Huson.

Mean total phosphorus concentrations exceeded the EPA criterion of 50 µg/l throughout Silver Bow Creek (stations 00-04), at the uppermost Clark Fork monitoring station (station 07), at two locations downstream of the Deer Lodge lagoon discharge (stations 10 and 11) and at one location immediately below the Missoula WWTP discharge (station 18). The EPA criterion of 1000 µg/l for total soluble inorganic nitrogen was routinely exceeded in Silver Bow Creek above the Warm Springs Ponds. However, no exceedences were documented at any time in the mainstem Clark Fork.

Tributary nutrient concentration data shown in Figures 3 and 4 also revealed some interesting patterns. Gold Creek (station 10.7) and Flint Creek (station 11.5) stood out as having

significantly elevated phosphorus concentrations relative to other Clark Fork tributaries (Figure 3) and were the only tributaries which routinely exceeded the total phosphorus criterion. A large percentage of the total phosphorus concentration in each of those streams was present as bioavailable SRP. The Gold Creek drainage bisects the geologic Phosphoria Formation. (Ingman, 1979). Flint Creek receives the Phillipsburg municipal wastewater discharge and is an important agricultural subbasin (Johnson and Schmidt, 1988). In general, tributaries to the lower Clark Fork contained the lowest phosphorus concentrations.

Most of the tributaries to the upper Clark Fork, and especially the Mill-Willow Bypass (05), Lost Creek (07.3), Racetrack Creek (08.3) and Dempsey Creek (08.7) contained elevated concentrations of soluble inorganic nitrogen, when compared to other Clark Fork tributaries. The Mill-Willow Bypass flows adjacent to an unsewered suburb of Anaconda (Opportunity) with a shallow groundwater table. The remaining tributaries drain agricultural areas and their quality was seasonally influenced by agricultural dewatering and irrigation return flows. Cottonwood Creek (09.3), the Little Blackfoot River (10.2), Rock Creek (12.5) and tributaries to the lower Clark Fork contained the lowest concentrations of nitrogen. None of the measured tributary nitrogen concentrations exceeded the EPA criterion value.

With few exceptions, wastewater discharges to the Clark Fork were roughly comparable in quality and contained very large concentrations of P and N. Of the ten effluents monitored, the Warm Springs lagoon (station 06.5) and Stone Container Corporation wastewater discharges (station 21) contained the smallest mean concentrations of phosphorus (Figure 5). The Missoula WWTP (station 17) and the Alberton and Superior lagoon discharges (stations 23.5 and 24.5 respectively) contained the highest average phosphorus concentrations. With the exception of the Drummond lagoon discharge (station 11.6), the majority of the phosphorus in the wastewaters monitored was present as

bioavailable SRP.

The Warm Springs, Drummond and Thompson Falls lagoon discharges (station 06.6, 11.6 and 27.6, respectively) and the Stone Container Corporation wastewater (staton 21) contained low concentrations of soluble inorganic nitrogen relative to the other wastewaters (Figure 6). Highest mean soluble nitrogen concentrations occurred in the Superior lagoon discharge.

The estimates of Silver Bow Creek and Clark Fork mainstem cumulative P and N loading shown in Figures 7 and 8 show a distinct pattern of the influence of population centers and incoming large tributaries. Both P and N loading increased abruptly in Silver Bow Creek from above (station 00) to below (station 01) the Butte WWTP discharge. The load declined gradually to above the Warm Springs treatment ponds (stations 03) and then fell off markedly below the ponds (station 04) presumably as a function of biological treatment and settling of particulate nutrients.

Nutrient loading in the mainstem Clark Fork (beginning at station 07) fluctuated in a relatively minor way downstream to Missoula (station 16). The Missoula WWTP discharge entering just below station 16 had a very pronounced effect on Clark Fork P and N loads. Greater than ten-fold increases in SRP and TSIN loads were noted from above to below the outfall.

Bioavailable phosphorus loads fell markedly from monitoring station 18, located 2 miles below the outfall and where mixing is assumed to first be complete, to station 20 -- a distance of about 10 stream miles. Rapid uptake by river algae during the July through December monitoring period was the presumed cause. SRP loads fluctuated by a relatively small margin from station 20 to the Idaho border, with a slight increase noted below the Flathead River confluence (station 27) and below Noxon Rapids Reservoir (station 29). Some of the apparent fluctuation in phosphorus loads at these stations likely resulted from poor precision in the loading estimates caused by low phosphorus concentrations and very large river flows. Total phosphorus loads showed peaks at station 22,

downstream from the Stone Container Corporation kraft mill and at stations below the Flathead River confluence.

Soluble inorganic nitrogen loads increased from monitoring station 18 to 20, unlike SRP, due to new sources of N associated with the Bitterroot River inflow. Other notable spikes were present downstream of the Flathead River and below Noxon Rapids Dam. Some of the apparent fluctuations in TSIN load at lower Clark Fork monitoring stations was probably due to the high frequency of nitrogen concentrations falling at or near our limits of analytical detection which made accurate estimates of nitrogen loading impossible.

Figures 9 and 11 indicate that of the tributaries and effluents monitored, the Missoula and Butte WWTP discharges (stations 17 and 0.5) and the Flathead River (station 26) contributed the largest bioavailable phosphorus (SRP) loads to the Clark Fork system during the six month monitoring period. The Deer Lodge lagoon discharge (station 9.5), the Bitterroot River (stations 18.5 and 19) and Gold and Flint Creeks (stations 10.7 and 11.5, respectively) contributed smaller but significant loads of SRP to the system. Other tributary and wastewater sources of SRP to the system were small by comparison but could contribute to localized problems in the river. The Flathead River was the single most significant source of total or particulate phosphorus to the Clark Fork, followed by the Bitterroot and Blackfoot (station 14) Rivers.

Similarly, the most significant sources of bioavailable nitrogen (TSIN) to the Clark Fork during the monitoring period included the Missoula WWTP discharge, the Flathead River, the Butte WWTP discharge and the Blackfoot and Bitterroot Rivers, in decreasing order of importance (Figures 10 and 12). The Deer Lodge lagoon discharge and Lost Creek were smaller but significant sources of bioavailable N. An increase in TSIN loading of four tons per year in the Bitterroot River from immediately above (station 18.5) to immediately below Missoula (station 19) is noteworthy and points to urban sources of loading, presumably septic tank leachate via groundwater inputs

to the lower Bitterroot River. This quantity of nitrogen loading is comparable to that discharged from the Deer Lodge lagoons.

Figures 13-15 show the monitored tributary and wastewater sources of P and N loading to the Clark Fork in relation to the estimated mainstem loads. The plots demonstrate that with few exceptions most measured instream increases in loading can be explained by inputs from the monitored tributaries and effluents. Of particular interest are the apparent, rapid decreases in P and N loads in several reaches of the river which suggests biological uptake and a net nutrient sink during the monitoring period. These reaches are downstream of the Missoula WWTP and Bitterroot River confluences (stations 18 and 20), where P and N decline rapidly, and below the Flathead River (stations 27 and 28) where N declines, but not P. This differential decline may be a result of the variable nutrient limitations to algal growth which are present in different reaches of the Clark Fork on a seasonal basis (Watson, 1989). It is likely that the phosphorus load discharged from the Missoula WWTP would not be assimilated as rapidly were it not for the Bitterroot River's major contribution of nitrogen to the same reach of the Clark Fork, due to nitrogen and phosphorus co-limitations to algal growth which are present there (Watson, 1989).

Continued monitoring of the river would be expected to show that these losses in nutrient loads occur on a seasonal basis only because as the algal accumulations eventually senesce and slough downstream, the temporary losses in nutrient loading would be accounted for.

5. CONCLUSIONS

Based on the previously presented information, it is possible to develop a preliminary nutrient budget for the Clark Fork River Basin in Montana and assign rankings for quality and total nutrient contribution for those sources which have been monitored during the first half of state fiscal year 1989. Bear in mind that, as the discussion on page 24 points out, nonpoint sources of nutrients would be expected to be less significant during this monitoring period than during the spring runoff period or during more normal weather patterns in general. The second half of the monitoring period, which is now nearing completion, will be expected to bear this out. It is also important to note that the Stone Container Corporation kraft mill discharges most of its total annual volume of wastewater during the months of March through June. As a result, its ranking for total nutrient loading among the other sources can be expected to shift upward as longer term monitoring data become available.

Tables 4 and 5 give rankings of wastewater discharges and tributaries to the Clark Fork in terms of quality (a higher ranking indicates greater average nutrient concentrations) and quantity (a higher ranking indicates a greater total discharge of nutrients) as documented during the period from July through December 1988.

About half the tributaries to the upper Clark Fork that were monitored, and especially Gold Creek, stood out as having poor water quality from the standpoint of bioavailable phosphorus concentrations. Similarly, a large percentage of the upper Clark Fork tributaries contained elevated concentrations of bioavailable nitrogen. Nitrogen concentrations in tributaries such as Dempsey, Racetrack and Lost Creeks and the Mill-Willow Bypass were elevated by as much a 5 to 17 times the mean concentrations found in other tributaries to the Clark Fork River. Various land use practices, seepage from unsewered communities and natural contributions from the geologic

Table 4. Ranking of Clark Fork Basin Nutrient Sources by Mean Concentrations of Phosphorus and Nitrogen 1/

	Source	Rank and Mean Concentration (µg/l)		
		SRP 2/	Total 3/	TSIN 4/
I.	Tributaries			
10.7	Gold Creek	1 (119)	1 (153)	11 (28)
11.5	Flint Creek	2 (43)	2 (63)	10 (32)
08.7	Dempsey Creek	3 (30)	3 (42)	1 (580)
09.3	Cottonwood Creek	4 (26)	4 (39)	15 (<10)
10.2	Little Blackfoot River	5 (19)	6 (30)	15 (<10)
10.5	Warm Springs Creek (near Phosphate)	6 (11)	7 (21)	8 (62)
05	Mill-Willow Bypass	7 (10)	5 (33)	4 (168)
06	Warm Springs Creek (near Warm Springs)	8 (9)	12 (11)	6 (73)
08.3	Racetrack Creek	8 (9)	8 (18)	2 (250)
07.3	Lost Creek	9 (7)	10 (16)	3 (233)
18.5	Bitterroot River at HWY 93	10 (6)	9 (17)	9 (57)
27.7	Prospect Creek	10 (6)	14 (9)	12 (22)
12.5	Rock Creek	11 (5)	11 (13)	15 (<10)
19	Bitterroot River near mouth	12 (4)	8 (18)	7 (67)
27.5	Thompson River	12 (4)	13 (10)	13 (15)
14	Blackfoot River	13 (2)	15 (8)	5 (78)
26	Flathead River	13 (2)	16 (7)	14 (12)
II.	Point Source Wastewater Discharges			
24.5	Superior lagoon	1 (6123)	1 (7215)	1 (16908)
23.5	Alberton lagoon	2 (5087)	2 (5950)	2 (12613)
17	Missoula WWTP	3 (4920)	3 (4958)	3 (12423)
00.5	Butte Metro WWTP	4 (3418)	4 (3658)	4 (9455)
07.7	Galen WWTP	5 (3073)	5 (3372)	5 (7045)
27.6	Thompson Falls lagoon	6 (2161)	6 (3158)	7 (1970)
09.5	Deer Lodge lagoon	7 (2058)	7 (2787)	6 (4840)
11.6	Drummond lagoon	8 (743)	8 (2065)	8 (1447)
21	Stone Container Corporation	9 (374)	9 (439)	9 (1275)
06.5	Warm Springs lagoon	10 (153)	10 (215)	10 (757)

1/ Based on an average of six monthly measurements made from July through December 1988.

2/ SRP = Soluble reactive phosphorus = dissolved orthophosphate.

3/ Total P = Total phosphorus.

4/ TSIN = Total soluble inorganic nitrogen = dissolved nitrate plus nitrite plus dissolved ammonia nitrogen.

Table 5. Ranking of Clark Fork Basin Nutrient Sources by Estimated Total Discharge of Phosphorus and Nitrogen 1/

	Source	Rank and Total Load (tons)		
		SRP 2/	Total P 3/	TSIN 4/
I.	Tributaries			
26	Flathead River	1 (5.86)	1 (28.17)	1 (50.78)
18.5	Bitterroot River at HWY 93	2 (1.60)	3 (5.45)	4 (18.77)
19	Bitterroot River near mouth	3 (1.26)	2 (6.13)	3 (22.60)
11.5	Flint Creek	4 (0.73)	5 (1.32)	6 (1.14)
10.7	Gold Creek	5 (0.67)	7 (0.90)	14 (0.19)
12.5	Rock Creek	6 (0.44)	6 (0.93)	11 (0.56)
10.2	Little Blackfoot River	7 (0.34)	9 (0.57)	16 (0.04)
14	Blackfoot River	8 (0.33)	4 (1.90)	2 (24.30)
27.5	Thompson River	9 (0.28)	8 (0.67)	8 (1.00)
27.7	Prospect Creek	10 (0.14)	10 (0.25)	9 (0.68)
05	Mill-Willow Bypass	11 (0.06)	11 (0.20)	7 (1.11)
07.3	Lost Creek	12 (0.04)	12 (0.12)	5 (3.71)
08.7	Dempsey Creek	12 (0.04)	13 (0.07)	10 (0.66)
09.3	Cottonwood Creek	13 (0.03)	15 (0.04)	17 (0.00)
06	Warm Springs Creek (near Warm Springs)	14 (0.02)	14 (0.05)	12 (0.38)
08.3	Racetrack Creek	15 (0.01)	16 (0.03)	13 (0.31)
10.5	Warm Springs Creek (near Phosphate)	15 (0.01)	16 (0.03)	15 (0.11)
II.	Point Source Wastewater Discharges			
17	Missoula WWTP	1 (22.13)	1 (22.25)	1 (55.54)
00.5	Butte Metro WWTP	2 (13.40)	2 (14.19)	2 (36.44)
09.5	Deer Lodge lagoon	3 (1.94)	3 (2.57)	3 (4.25)
24.5	Superior lagoon	4 (0.35)	4 (0.41)	4 (0.95)
07.7	Galen WWTP	5 (0.16)	6 (0.18)	5 (0.37)
27.6	Thompson Falls lagoon	6 (0.11)	7 (0.16)	9 (0.12)
23.5	Alberton lagoon	7 (0.07)	8 (0.08)	7 (0.20)
11.6	Drummond lagoon	8 (0.06)	5 (0.21)	8 (0.13)
21	Stone Container Corporation	9 (0.06)	8 (0.08)	6 (0.27)
06.5	Warm Springs lagoon	10 (0.01)	9 (0.02)	8 (0.13)

1/ Estimated total phosphorus and nitrogen discharge for the period of July 1 through December 31, 1988.

2/ SRP = soluble reactive phosphorus = dissolved orthophosphate.

3/ Total P = Total phosphorus.

4/ TSIN = Total soluble inorganic nitrogen = dissolved nitrate plus nitrite plus dissolved ammonia nitrogen.

Phosphoria Formation are suspected as contributing to the documented elevated nutrient concentrations.

Point source wastewater discharges to the Clark Fork Basin were somewhat variable with respect to nutrient quality. However, each of the discharges contained very high concentrations of bioavailable phosphorus and nitrogen.

A comparison of the cumulative nutrient loading from all sources monitored indicates that the 17 tributaries together discharged quantities of bioavailable nitrogen and total phosphorus comparable to the 10 wastewater discharges combined. These figures are not included on Table 5 and amount to a total of 126 tons of TSIN and 47 tons of total phosphorus for the tributaries versus 98 tons of TSIN and 40 tons of total phosphorus for the wastewater discharges. However, the bioavailable phosphorus discharged via the wastewaters was more than three times the amount contributed by the tributaries (38 versus 12 tons). In the long term, the tributary contributions of nutrients can be expected to be much greater than what was documented during this six month period because of the low streamflows and dry conditions that prevailed. Also, the 17 tributaries monitored contributed on average only about two thirds of the total streamflow at the Montana-Idaho border. Numerous other small tributaries make up the remaining discharge and nutrient contributions from those sources have not been examined.

Of the tributaries examined, the Flathead, Bitterroot and Blackfoot Rivers accounted for some 63 percent of the tributary bioavailable phosphorus loading and about 77 percent of the total phosphorus and bioavailable nitrogen loading. The other smaller tributaries contributed the remaining 23-37 percent of the total tributary nutrient loading.

Of the 10 effluents, the Missoula, Butte and Deer Lodge wastewater discharges contributed about 98 percent of the bioavailable phosphorus and nitrogen loading and some 97 percent of the total phosphorus loading. The seven other point source discharges collectively accounted for the remaining two to three

percent of the nutrient loading. It is interesting to note that phosphorus loading in the effluents averaged greater than 95 percent bioavailable P. The Stone Container Corporation wastewater discharge contributed a small percent of the total effluent nutrient loading during this monitoring period. However, as longer term monitoring data become available and the spring high wastewater discharge period is considered, contributions of nutrients from that source will become more significant relative to the other sources.

6. RECOMMENDATIONS

Montana's first six months effort under the Clean Water Act Section 525 Study has allowed us to take an initial look at where nutrients in the Clark Fork watershed are originating. A preliminary ranking of tributary and point sources of nutrients and a partial nutrient budget have been developed for the Montana portion of the basin.

At the present time, monitoring is continuing on a twice-monthly basis at each of the 51 monitoring stations described in this report. Following the completion of one full year of data collection in late June 1989, it is recommended that a similar analysis of the data be conducted to fully assess the importance of nonpoint nutrient sources in tributary drainages and along reaches of the mainstem Clark Fork relative to point source discharges. Montana will receive a similar level of funding for nutrient monitoring in the Clark Fork Basin in state FY 1990. This data analysis would provide a basis for program modifications in the second year of monitoring. Because of the apparent small nutrient contributions from many of the municipal wastewater treatment plants, it is anticipated at this time that second year monitoring efforts will focus more on tributaries to the Clark Fork and nonpoint source nutrient contributions. Comments from interested parties on this report and relating to our continued monitoring efforts in the basin are invited.

7. LITERATURE CITED

Ingman, G. L. and L. L. Bahls. 1979. An Assessment of Mining Impacts on Quality of Surface Waters in the Flint Creek Range, Montana. Montana Department of Health and Environmental Sciences. September, 1979.

Ingman, G. L. 1988. Algal Nutrients in the Clark Fork River System. Montana Department of Health and Environmental Sciences. April, 1988.

Johnson, H. E. and C. L. Schmidt. 1988. Clark Fork Basin Project Status Report and Action Plan. Clark Fork Basin Project. Office of the Governor. December 1988.

Montana Department of Health and Environmental Sciences. 1974. Lab Procedures Manual - Analysis and Reporting of Water Quality Samples. March, 1974 (Revised 1988)

Montana Department of Health and Environmental Sciences. 1985 Draft Environmental Impact Statement for Champion International Frenchtown Mill Discharge Permit MT-0000035. December, 1985.

Montana Department of Health and Environmental Sciences, 1986. Montana Water Quality -- The 1986 Montana 305(b) Report. May, 1986.

Montana Department of Health and Environmental Sciences. 1988a. Preliminary Environmental Review - Missoula Wastewater Treatment Plant MPDES Permit No. MT-0022594. January, 1988.

Montana Department of Health and Environmental Sciences, 1988b. Clark Fork River Basin Expanded Nutrient Monitoring Program Work Plan. February, 1988.

U. S. Environmental Protection Agency. 1986. Quality Criteria for Water. EPA 440/5-86-001. May, 1986.

Watson, V. 1989. Control of Attached Algae by Nitrogen and Phosphorus in the Clark Fork River. Montana Department of Health and Environmental Sciences. May 1989.

8. ACKNOWLEDGEMENTS

Loren Bahls of the Montana Water Quality Bureau served as Montana's representative on the three-state Section 525 Clean Water Act Study steering committee, performed administrative duties associated with the state grant and provided valuable guidance to the monitoring program. Lee Shanklin of the U.S. EPA Montana Operations Office served as steering committee chairperson and coordinated the administration of EPA grant funds. Judy Halm and Diane Ertman of the MDHES Chemistry Laboratory Bureau performed all chemical analyses and consistently went out of their way to accommodate the variable sample collection schedules and short sample holding times. Brad Towe, formerly with the Water Quality Bureau, assisted with field monitoring activities and prepared field filtration gear. Mel White of the U.S. Geological Survey courteously provided streamflow data, oftentimes on short notice. Stewart Guttenberger of the Idaho U.S. Geological Survey and Guy Engebretson of the Montana Power Company provided streamflow data for the Clark Fork below Cabinet Gorge and Thompson Falls Dams, respectively. Pamela Brewster patiently entered the raw data into the computer, printed the spreadsheets and typed the final report.

APPENDIX A.

CLARK FORK BASIN NUTRIENT MONITORING DATA

MAINSTEM MONITORING STATIONS

(including Silver Bow Creek)

Monitoring Station:00 Silver Bow Creek above Butte WWTP

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	6.3	(I)	12.4	7.72	9	58	1770	20	200	1790
Aug 15	8.1	(I)	9.7	7.88	19	77	1740	40	400	1780
Sep 12	8.1	(I)	7.3	6.41	21	92	1560	80	500	1640
Oct 11	8.3	(I)	6.2	7.15	13	82	1780	60	400	1840
Nov 14	7.7	(I)	3.8	6.99	10	111	1840	90	600	1930
Dec 12	7.3	(I)	4.6	7.33	12	110	1910	90	500	2000
N=	6		6	6	6	6	6	6	6	6
Max	8.3		12.4	7.88	21	111	1910	90	600	2000
Min	6.3		3.8	6.41	9	58	1560	20	200	1640
Mean	7.6		7.3	7.25	14	88	1767	63	433	1830

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:01 Silver Bow Creek below Colorado Tailings

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	15.0 (M)	14.3	7.10	1070	1230	2730	1590	2800	4320
Aug 15	21.0 (M)	12.8	7.78	1100	1350	2110	1780	3200	3890
Sep 12	18.0 (M)	10.1	6.85	919	1340	1920	1760	2400	3680
Oct 11	16.0 (M)	9.1	7.20	1180	1490	1550	3010	3700	4560
Nov 14	13.0 (M)	6.1	7.07	935	1890	1350	3620	4700	4970
Dec 12	20.6 (I)	6.1	7.33	921	1610	1440	4230	4800	5670
N=	6	6	6	6	6	6	6	6	6
Max	21.0	14.3	7.78	1180	1890	2730	4230	4800	5670
Min	13.0	6.1	6.85	919	1230	1350	1590	2400	3680
Mean	17.3	9.8	7.22	1021	1485	1850	2665	3600	4515

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:02 Silver Bow Creek at Miles Crossing near Ramsay

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	13.5 (I)	16.4	8.11	300	610	2140	40	1000	2180
Aug 15	11.7 (I)	12.7	7.95	597	912	3060	20	1100	3080
Sep 12	21.0 (I)	7.8	7.35	352	833	3370	270	1000	3640
Oct 11	19.4 (I)	7.9	7.55	514	920	2770	630	1300	3400
Nov 14	24.6 (I)	2.9	7.40	323	689	1700	1960	2500	3660
Dec 12	23.2 (I)	3.1	7.53	380	874	1500	2330	2600	3830
N=	6	6	6	6	6	6	6	6	6
Max	24.6	16.4	8.11	597	920	3370	2330	2600	3830
Min	11.7	2.9	7.35	300	610	1500	20	1000	2180
Mean	18.9	8.5	7.65	411	806	2423	875	1583	3298

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA

Monitoring Station:03 Silver Bow Creek at frontage road above Warm Springs Ponds

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	28.6	(I)	17.4	8.37	284	330	980	10 <	1100	980
Aug 15	16.4	(I)	14.1	8.10	123	353	1490	20	1000	1510
Sep 12	29.3	(I)	6.9	8.00	138	736	2160	60	1300	2220
Oct 11	26.6	(I)	7.9	7.70	174	443	1920	40	700	1960
Nov 14	31.1	(I)	1.7	7.48	153	425	1680	750	1500	2430
Dec 12	34.3	(I)	1.1	7.82	220	998	1540	1210	1900	2750
N=	6		6	6	6	6	6	6	6	6
Max	34.3		17.4	8.37	284	998	2160	1210	1900	2750
Min	16.4		1.1	7.48	123	330	980	10 <	700	980
Mean	27.7		8.2	7.91	182	548	1628	347	1250	1975

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA
Monitoring Station:04 Discharge from AMC Pond 2 (Silver Bow Creek)

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	22.6 (I)	21.2	9.39	109	151	40	50	800	90
Aug 15	5.7 (I)	19.4	8.30	137	167	60	30	800	90
Sep 13	4.6 (I)	11.3	8.60	76	113	20	30	700	50
Oct 11	17.7 (I)	13.2	8.45	24	50	10	10 <	500	10
Nov 14	12.5 (I)	1.0	7.66	9	40	10 <	10 <	500	10 <
Dec 12	19.0 (I)	2.5	8.01	13	55	460	90	400	550
N=	6	6	6	6	6	6	6	6	6
Max	22.6	21.2	9.39	137	167	460	90	800	550
Min	4.6	1.0	7.66	9	40	10 <	10 <	400	10 <
Mean	13.7	11.4	8.40	61	96	98	33	617	132

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:07 Clark Fork below Warm Springs Creek

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	34.2 (I)	20.8	8.89	70	112	80	20	800	100
Aug 15	15.1 (I)	18.2	8.07	57	82	100	30	600	130
Sep 12	16.9 (I)	11.5	8.15	26	54	110	60	600	170
Oct 11	48.9 (I)	12.4	7.65	14	36	40	20	400	60
Nov 14	48.5 (I)	3.0	7.99	3	21	70	10	300	80
Dec 12	53.1 (I)	3.8	8.48	7	28	260	70	300	330
N=	6	6	6	6	6	6	6	6	6
Max	53.1	20.8	8.89	70	112	260	70	800	330
Min	15.1	3.0	7.65	3	21	40	10	300	60
Mean	36.1	11.6	8.21	30	56	110	35	500	145

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:08 Clark Fork near Dempsey

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)		Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	10.7	(I)	20.9	8.24	18	44	10	10	<	600	10
Aug 16	3.1	(I)		8.07	15	25	70	10	<	400	70
Sep 13	8.1	(I)	7.9	7.65	17	36	80	10		500	90
Oct 12	69.7	(I)	8.2	7.61	6	24	30	10	<	400	30
Nov 15	89.1	(I)	0.1	7.88	8	48	230	10	<	500	230
Dec 12	114.8	(I)	4.3	8.24	8	33	340	10	<	500	340
N=	6		5	6	6	6	6	6		6	6
Max	114.8		20.9	8.24	18	48	340	10		600	340
Min	3.1		0.1	7.61	6	24	10	10	<	400	10
Mean	49.2		8.3	7.95	12	35	127	10	<	483	128

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989
Monitoring Station:09 Clark Fork at Deer Lodge

MONTANA WATER QUALITY BUREAU

GARY INGMAN

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	40.0 (M)	14.9	7.78	6	20	200	10 <	400	200
Aug 16	25.0 (M)		8.15	9	12	240	10 <	500	240
Sep 13	49.0 (M)	8.8	8.10	6	22	260	10 <	400	260
Oct 12	110.0 (M)	8.7	8.45	4	32	70	10	400	80
Nov 15	139.0 (M)	0.5	7.90	5	34	340	10 <	400	340
Dec 13	206.8 (M)	2.8	7.80	7	69	400	10 <	500	400
N=	6	5	6	6	6	6	6	6	6
Max	206.8	14.9	8.45	9	69	400	10	500	400
Min	25.0	0.5	7.78	4	12	70	10 <	400	80
Mean	95.0	7.1	8.03	6	32	252	10 <	433	253

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989
Monitoring Station:10 Clark Fork above Little Blackfoot River

MONTANA WATER QUALITY BUREAU

GARY INGMAN

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	40.0 (E)	17.4	8.00	92	116	40	10 <	800	40
Aug 16	34.1 (I)		8.23	72	90	10 <	10 <	500	10 <
Sep 13	55.2 (I)	8.3	8.20	50	80	20	10 <	600	20
Oct 12	123.4 (I)	13.1	8.92	17	55	10	10 <	400	10
Nov 15	150.5 (I)	1.1	8.11	19	56	310	10 <	400	310
Dec 13	193.0 (I)	2.9	7.80	17	116	430	20	800	450
N=	6	5	6	6	6	6	6	6	6
Max	193.0	17.4	8.92	92	116	430	20	800	450
Min	34.1	1.1	7.80	17	55	10 <	10 <	400	10 <
Mean	99.4	8.6	8.21	45	86	135	10 <	583	138

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA

Monitoring Station:11 Clark Fork at Gold Creek Bridge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	156.0 (M)	15.0	8.13	84	74	50	10 <	500	50
Aug 15	76.0 (M)	14.3	8.13	42	52	10 <	10 <	400	10 <
Sep 13	85.0 (M)	8.3	7.89	31	70	10 <	10 <	500	10 <
Oct 11	177.0 (M)	9.2	7.67	18	56	10 <	10 <	400	10 <
Nov 15	237.0 (M)	0.5	7.88	11	38	180	10 <	300	180
Dec 13	285.0 (M)	3.4	7.80	18	104	320	10 <	600	320
N=	6	6	6	6	6	6	6	6	6
Max	285.0	15.0	8.13	84	104	320	10 <	600	320
Min	76.0	0.5	7.67	11	38	10 <	10 <	300	10 <
Mean	169.3	8.5	7.92	34	66	92	10 <	450	92

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:12 Clark Fork at Bonita

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	271.0 (M)	18.0	8.16	32	42	10 <	10 <	400	10 <
Aug 15	128.0 (M)	19.7	8.21	9	18	10 <	10 <	400	10 <
Sep 13	176.0 (M)	12.0	8.08	6	40	10 <	10 <	500	10 <
Oct 11	390.0 (M)	11.8	7.86	15	51	10 <	10 <	400	10 <
Nov 15	453.0 (M)	2.7	7.99	10	30	10 <	10 <	200	10 <
Dec 13	474.0 (E)	4.3	7.87	7	67	120	10 <	400	120
N=	6	6	6	6	6	6	6	6	6
Max	474.0	19.7	8.21	32	67	120	10 <	500	120
Min	128.0	2.7	7.86	6	18	10 <	10 <	200	10 <
Mean	315.3	11.4	8.03	13	41	20	10 <	383	20

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:13 Clark Fork at Turah

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	659.0 (M)	16.8	8.23	9	18	20	10 <	400	20
Aug 15	284.0 (M)	20.3	8.14	7	15	10	10 <	500	10
Sep 13	239.0 (M)	11.8	8.02	3	19	10	10 <	400	10
Oct 11	515.0 (M)	12.0	7.91	8	26	20	10 <	200	20
Nov 15	633.0 (I)	3.0	8.00	8	22	20	10 <	200 <	20
Dec 13	701.7 (I)	4.3	7.93	5	34	60	10 <	300	60
N=	6	6	6	6	6	6	6	6	6
Max	701.7	20.3	8.23	9	34	60	10 <	500	60
Min	239.0	3.0	7.91	3	15	10	10 <	200 <	10
Mean	505.3	11.4	8.04	7	22	23	10 <	300	23

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:15 Clark Fork below Milltown Dam

Instantaneous Values

Date	Streamflow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	1300.0 (M)	18.0	8.06	8	35	20	30	600	50
Aug 15	655.0 (M)	19.4	8.05	7	15	10 <	10 <	400	10 <
Sep 13	729.0 (M)	13.2	7.99	3	13	10 <	10 <	300	10 <
Oct 11	899.0 (M)	12.2	7.82	7	17	10	10 <	200	10
Nov 15	1220.0 (M)	3.1	7.48	5	20	10	10 <	200	10
Dec 13	1230.0 (E)	4.1	7.89	3	21	40	10 <	200 <	40
N=	6	6	6	6	6	6	6	6	6
Max	1300.0	19.4	8.06	8	35	40	30	600	50
Min	655.0	3.1	7.48	3	13	10 <	10 <	200 <	10 <
Mean	1005.5	11.7	7.88	6	20	13	10 <	283	18

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:16 Clark Fork above Missoula WWTP

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	1300.0	(E)	18.5	8.07	7	35	20	10	600	30
Aug 16	655.0	(E)	19.3	8.06	4	15	20	10 <	400	20
Sep 13	729.0	(E)	14.5	8.09	2	17	10 <	10 <	300	10 <
Oct 11	899.0	(E)	13.0	7.95	6	17	10 <	10 <	200	10 <
Nov 15	1220.0	(E)	3.3	7.88	4	16	10 <	10 <	200 <	10 <
Dec 13	1230.0	(E)	3.7	8.00	2	20	20	10 <	200 <	20
N=	6		6	6	6	6	6	6	6	6
Max	1300.0		19.3	8.09	7	35	20	10	600	30
Min	655.0		3.3	7.88	2	15	10 <	10 <	200 <	10 <
Mean	1005.5		12.1	8.01	4	20	10	10 <	250	12

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:18 Clark Fork at Shuffield's

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	1300.0	(E)	18.5	8.09	41	68	100	50	400	150
Aug 16	652.0	(E)	20.7	8.09	96	106	60	100	600	160
Sep 13	729.0	(E)	15.0	8.05	66	86	110	30	400	140
Oct 11	899.0	(E)	13.0	7.99	61	66	50	60	300	110
Nov 15	1220.0	(E)	3.3	7.89	40	55	10 <	80	500	80
Dec 13	1230.0	(E)	3.6	7.66	36	65	50	80	200	130
N=	6		6	6	6	6	6	6	6	6
Max	1300.0		20.7	8.09	96	106	110	100	600	160
Min	652.0		3.3	7.66	36	55	10 <	30	200	80
Mean	1005.0		12.4	7.96	57	74	62	67	400	128

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:20 Clark Fork at Harper Bridge

Instantaneous Values

Date	Streamflow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	2040.0	(M)	16.2	7.82	16	34	100	20	300	120
Aug 16	1050.0	(M)	20.5	8.14	13	50	50	10 <	200	50
Sep 13	1090.0	(M)	15.3	8.30	10	25	50	10 <	200	50
Oct 12	1320.0	(M)	11.1	7.64	19	34	90	20	200	110
Nov 16	1990.0	(M)	3.5	7.64	14	26	60	10	200	70
Dec 14	2200.0	(M)	3.3	7.59	12	43	90	10	200 <	100
N=	6		6	6	6	6	6	6	6	6
Max	2200.0		20.5	8.30	19	50	100	20	300	120
Min	1050.0		3.3	7.59	10	25	50	10 <	200 <	50
Mean	1615.0		11.7	7.86	14	35	73	10	200 <	83

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:22 Clark Fork at Huson

Instantaneous Values

Date	Streamflow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	2040.0 (E)	16.8	7.91	20	38	90	10 <	200	90
Aug 16	1050.0 (E)	21.0	8.16	10	31	10 <	10 <	300	10 <
Sep 13	1090.0 (E)	15.7	8.32	10	35	10	10 <	300	10
Oct 12	1320.0 (E)	11.6	7.69	18	38	40	10 <	300	40
Nov 16	1990.0 (E)	3.7	7.66	17	32	50	10 <	200	50
Dec 14	2200.0 (E)	3.3	7.56	14	108	90	10	300	100
N=	6	6	6	6	6	6	6	6	6
Max	2200.0	21.0	8.32	20	108	90	10	300	100
Min	1050.0	3.3	7.56	10	31	10 <	10 <	200	10 <
Mean	1615.0	12.0	7.88	15	47	47	10 <	267	48

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:23 Clark Fork near Alberton

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	2040.0 (E)	17.0	8.01	17	31	60	10 <	300	60
Aug 16	1050.0 (E)	21.3	8.11	14	27	10 <	10 <	200	10 <
Sep 14	1130.0 (E)	13.2	8.05	11	38	10 <	10 <	300	10 <
Oct 12	1320.0 (E)	11.6	7.81	12	31	10 <	10 <	200	10 <
Nov 16	1990.0 (E)	3.7	7.86	14	28	30	10 <	200 <	30
Dec 14	2200.0 (E)	3.2	7.75	11	46	70	10 <	400	70
N=	6	6	6	6	6	6	6	6	6
Max	2200.0	21.3	8.11	17	46	70	10 <	400	70
Min	1050.0	3.2	7.75	11	27	10 <	10 <	200 <	10 <
Mean	1621.7	11.7	7.93	13	34	27	10 <	233	27

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:24 Clark Fork at Superior

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	2040.0 (E)	17.5	8.36	7	15	60	10 <	200	60
Aug 17	1050.0 (E)	15.7	8.03	7	15	80	10 <	200 <	80
Sep 14	1130.0 (E)	13.0	8.00	6	25	10	10 <	200	10
Oct 12	1320.0 (E)	11.7	7.86	8	26	10 <	10 <	200	10 <
Nov 16	1990.0 (E)	4.3	7.96	9	22	20	10 <	300	20
Dec 14	2200.0 (E)	3.3	7.85	7	24	50	10 <	200 <	50

	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
N=	6	6	6	6	6	6	6	6	6
Max		17.5	8.36	9	26	80	10 <	300	80
Min		3.3	7.85	6	15	10 <	10 <	200 <	10 <
Mean		10.9	8.01	7	21	37	10 <	200 <	37

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:25 Clark Fork above Flathead River

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	3090.0 (M)	16.6	8.00	5	12	20	10 <	300	20
Aug 17	1570.0 (M)	20.1	8.14	5	14	10 <	10 <	300	10 <
Sep 14	1520.0 (M)	15.1	7.99	2	15	10	10 <	200	10
Oct 12	1850.0 (M)	13.0	7.88	5	19	20	10 <	200	20
Nov 16	2640.0 (M)	4.7	7.39	7	15	20	10 <	300	20
Dec 14	2800.0 (M)	3.3	7.85	4	17	30	10 <	200 <	30
N=	6	6	6	6	6	6	6	6	6
Max	3090.0	20.1	8.14	7	19	30	10 <	300	30
Min	1520.0	3.3	7.39	2	12	10 <	10 <	200 <	10 <
Mean	2245.0	12.1	7.88	5	15	17	10 <	217	17

NOTE:Estimated streamflows are denoted with an (E) following the value.

Instantaneous streamflows (gaged) are denoted with an (I) following the value.

Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:27 Clark Fork above Thompson Falls Reservoir

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	8330.0 (M)	18.2	7.98	2	7	40	10 <	200 <	40
Aug 17	5370.0 (M)	21.6	8.08	2	10	10 <	10 <	200	10 <
Sep 14	5240.0 (M)	17.0	7.94	1	8	10	10 <	200	10
Oct 12	10300.0 (M)	15.2	7.84	1	8	10	10 <	200 <	10
Nov 17	13500.0 (M)	5.6	7.47	2	10	10 <	10 <	200 <	10 <
Dec 14	12700.0 (M)	3.7	7.78	1	10	10 <	10 <	200 <	10 <
N=	6	6	6	6	6	6	6	6	6
Max	13500.0	21.6	8.08	2	10	40	10 <	200	40
Min	5240.0	3.7	7.47	1	7	10 <	10 <	200 <	10 <
Mean	9240.0	13.6	7.85	2	9	10	10 <	200 <	10

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:28 Clark Fork below Thompson Falls Dam

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	8710.0	(M)	19.4	8.04	2	11	10 <	10 <	200 <	10 <
Aug 18	5560.0	(M)	21.7	8.02	3	10	10	10 <	200	10
Sep 15	5541.0	(M)	16.8	7.89	3	11	10	10 <	200	10
Oct 13	10124.0	(M)	14.6	7.78	1	7	10	10 <	200 <	10
Nov 17	13337.0	(M)	5.7	7.72	1	10	10 <	10 <	200 <	10 <
Dec 14	13058.0	(M)	3.3	7.61	1	10	10 <	10 <	200 <	10 <

	Stream-flow	Water Temp.	pH	Diss.Ortho P	Total P	Diss.NO3+NO2	Diss.NH3+NH4	Total KJL-N	TSIN
N=	6	6	6	6	6	6	6	6	6
Max	13337.0	21.7	8.04	3	11	10	10 <	200	10
Min	5541.0	3.3	7.61	1	7	10 <	10 <	200 <	10 <
Mean	9388.3	13.6	7.84	2	10	10 <	10 <	200 <	10 <

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:29 Clark Fork at Noxon Bridge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	10300.0 (M)	19.7	7.83	5	9	20	10	200 <	30
Aug 18	5090.0 (M)	21.0	7.78	7	16	50	10 <	200	50
Sep 15	4100.0 (M)	20.1	7.75	4	14	50	10 <	200	50
Oct 12	10700.0 (M)	15.9	7.73	2	8	20	10 <	200	20
Nov 17	15500.0 (M)	9.2	7.69	2	12	10 <	10 <	200	10 <
Ded 15	19200.0 (M)	3.2	7.54	1	10	20	10 <	200 <	20

N=	6	6	6	6	6	6	6	6	6
Max	19200.0	21.0	7.83	7	16	50	10	200	50
Min	4100.0	3.2	7.54	1	8	10 <	10 <	200 <	10 <
Mean	10815.0	14.9	7.72	4	12	27	10 <	200 <	28

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:30 Clark Fork below Cabinent Gorge Dam

Instantaneous Values

Date	Stream- flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	14400.0	(M)	19.8	7.92	2	8	10 <	10 <	200 <	10 <
Aug 18	6650.0	(M)	20.5	7.89	5	7	30	10 <	200	30
Sep 15	5900.0	(M)	18.9	7.88	2	13	20	10 <	200	20
Oct 12	13400.0	(M)	15.4	7.67	1	8	20	10 <	200	20
Nov 17	17700.0	(M)	9.3	7.70	2	12	10	10 <	200 <	10
Dec 15	22500.0	(M)	4.2	7.65	1	12	30	10 <	200 <	30
N=	6		6	6	6	6	6	6	6	6
Max	22500.0		20.5	7.92	5	13	30	10 <	200	30
Min	5900.0		4.2	7.65	1	7	10 <	10 <	200 <	10 <
Mean	13425.0		14.7	7.79	2	10	18	10 <	200 <	18

NOTE:Estimated streamflows are denoted with an (E) following the value.

Instantaneous streamflows (gaged) are denoted with an (I) following the value.

Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

APPENDIX B.

CLARK FORK BASIN NUTRIENT MONITORING DATA

TRIBUTARY MONITORING STATIONS

Monitoring Station:05 Mill-Willow Bypass at mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	9.6 (I)	20.5	8.16	11	38	50	70	700	120
Aug 15	9.7 (I)	21.6	8.08	21	32	100	80	600	180
Sep 12	9.2 (I)	15.9	7.90	11	43	110	110	600	220
Oct 11	14.6 (I)	15.0	7.45	7	28	60	60	500	120
Nov 14	15.9 (I)	4.1	7.76	5	30	10	90	500	100
Ded 12	18.9 (I)	6.1	8.05	6	24	190	80	300	270
N=	6	6	6	6	6	6	6	6	6
Max	18.9	21.6	8.16	21	43	190	110	700	270
Min	9.2	4.1	7.45	5	24	10	60	300	100
Mean	13.0	13.9	7.90	10	33	87	82	533	168

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:06 Warm Springs Creek at mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	1.4 (I)	20.6	8.11	8	12	40	10 <	400	40
Aug 15	0.4 (I)	20.9	8.17	16	8	20	10 <	300	20
Sep 12	2.6 (I)	10.7	7.50	16	14	100	10 <	400	100
Oct 11	9.8 (I)	11.0	7.35	6	11	90	10 <	400	90
Nov 14	18.2 (I)	2.9	7.89	3	11	80	10 <	200	80
Dec 12	17.5 (I)	4.0	8.28	2	9	110	10 <	200 <	110
N=	6	6	6	6	6	6	6	6	6
Max	18.2	20.9	8.28	16	14	110	10 <	400	110
Min	0.4	2.9	7.35	2	8	20	10 <	200 <	20
Mean	8.3	11.7	7.88	9	11	73	10 <	283	73

NOTE:Estimated streamflows are denoted with an (E) following the value.

Instantaneous streamflows (gaged) are denoted with an (I) following the value.

Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:07.3 Lost Creek near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	2.0 (I)			11	27	10 <	10 <	600	10 <
Aug 15	3.8 (I)			11	20	10	10 <	400	10
Sep 12	6.2 (I)			5	16	150	10	400	160
Oct 11	23.3 (I)			4	7	310	10 <	300	310
Nov 14	39.4 (I)			4	14	440	10 <	200	440
Dec 12	40.5 (I)			4	13	480	10 <	200	480
N=	6	0	0	6	6	6	6	6	6
Max	40.5			11	27	480	10	600	480
Min	2.0			4	7	10 <	10 <	200	10 <
Mean	19.2			7	16	232	10 <	350	233

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:08.3 Racetrack Creek near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	1.6 (I)			11	30	200	10 <	500	200
Aug 16	1.8 (I)			17	21	120	10 <	400	120
Sep 13	0.9 (I)			9	16	320	10 <	200	320
Oct 12	1.9 (I)			8	11	350	10 <	200	350
Nov 15	0.9 (I)			5	13	360	10 <	200 <	360
Dec 13	12.9 (I)			5	14	150	10 <	200 <	150
N=	6	0	0	6	6	6	6	6	6
Max	12.9			17	30	360	10 <	500	360
Min	0.9			5	11	120	10 <	200 <	120
Mean	3.3			9	18	250	10 <	217	250

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA
Monitoring Station:8.7 Dempsey Creek near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	1.2 (I)			28	35	350	20	200	370
Aug 16	1.5 (I)			31	37	610	20	300	630
Sep 13	2.2 (I)			28	38	750	20	300	770
Oct 12	1.9 (I)			30	37	770	10	200	780
Nov 15	2.0 (I)			30	46	670	10 <	200	670
Dec 13	8.3 (I)			33	58	250	10	300	260
N=	6	0	0	6	6	6	6	6	6
Max	8.3			33	58	770	20	300	780
Min	1.2			28	35	250	10 <	200	260
Mean	2.8			30	42	567	13	250	580

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:09.3 Cottonwood Creek near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	2.5 (I)			80	102	10 <	10 <	600	10 <
Aug 16	1.1 (I)			22	41	10 <	10 <	400	10 <
Sep 13	1.4 (I)			10	22	10 <	10 <	300	10 <
Oct 12	1.7 (I)			15	19	10	10 <	200	10
Nov 15	1.6 (I)			17	26	10 <	10 <	200 <	10 <
Dec 13	0.9 (I)			13	22	10 <	10 <	200 <	10 <
N=	6	0	0	6	6	6	6	6	6
Max	2.5			80	102	10	10 <	600	10
Min	0.9			10	19	10 <	10 <	200 <	10 <
Mean	1.5			26	39	10 <	10 <	250	10 <

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:10.2 Little Blackfoot River near mouth

Instantaneous Values

Date	Stream- flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	70.0 (M)			22	33	10	10 <	200	10
Aug 16	12.0 (M)			23	25	10 <	10 <	200	10 <
Sep 13	21.0 (M)			23	38	10 <	10 <	400	10 <
Oct 12	41.0 (M)			16	28	10 <	10 <	300	10 <
Nov 15	44.0 (M)			16	27	10 <	10 <	300	10 <
Dec 13	51.8 (I)			13	30	10 <	10 <	200	10 <
N=	6	0	0	6	6	6	6	6	6
Max	70.0			23	38	10	10 <	400	10
Min	12.0			13	25	10 <	10 <	200	10 <
Mean	40.0			19	30	10 <	10 <	267	10 <

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:10.5 Warm Springs Creek (near Phosphate) near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	0.5 (I)			10	17	10 <	50	200	50
Aug 16	0.8 (I)			21	21	10 <	10 <	400	10 <
Sep 13	1.9 (I)			13	21	10	10 <	300	10
Oct 12	3.6 (I)			9	20	10	10 <	200	10
Nov 15	4.1 (I)			5	17	80	10 <	200 <	80
Dec 13	4.1 (I)			10	31	220	10 <	300	220
N=	6	0	0	6	6	6	6	6	6
Max	4.1			21	31	220	50	400	220
Min	0.5			5	17	10 <	10 <	200 <	10 <
Mean	2.5			11	21	53	10 <	233	62

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:10.7 Gold Creek near mouth

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	17.0	(I)			108	119	20	10 <	300	20
Aug 16	4.1	(I)			144	147	10 <	10	500	10
Sep 13	7.9	(I)			83	106	20	10	400	30
Oct 12	11.0	(I)			127	192	20	10 <	400	20
Nov 15	10.7	(I)			122	133	20	10 <	300	20
Dec 13	17.2	(I)			131	223	60	10	600	70
N=	6		0	0	6	6	6	6	6	6
Max	17.2				144	223	60	10	600	70
Min	4.1				83	106	10 <	10 <	300	10
Mean	11.3				119	153	23	10 <	417	28

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:11.5 Flint Creek at New Chicago

Instantaneous Values

Date	Stream- flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	29.4 (I)			69	92	20	10 <	500	20
Aug 16	9.7 (I)			67	73	10 <	10 <	500	10 <
Sep 13	13.7 (I)			45	58	30	10	400	40
Oct 12	38.8 (I)			36	53	10 <	10 <	300	10 <
Nov 15	91.3 (I)			20	46	40	10 <	200	40
Dec 13	100.2 (I)			23	55	90	10 <	300	90
N=	6	0	0	6	6	6	6	6	6
Max	100.2			69	92	90	10	500	90
Min	9.7			20	46	10 <	10 <	200	10 <
Mean	47.2			43	63	30	10 <	367	32

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:12.5 Rock Creek at USGS station near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	335.0 (M)			6	11	10	10 <	200	10
Aug 15	157.0 (M)			8	9	10 <	10 <	400	10 <
Sep 13	176.0 (M)			3	11	10	10 <	200	10
Oct 11	177.0 (M)			4	10	10	10 <	200 <	10
Nov 15	178.0 (M)			5	14	10 <	10 <	200	10 <
Dec 13	183.0 (M)			5	25	20	10 <	200 <	20
N=	6	0	0	6	6	6	6	6	6
Max	335.0			8	25	20	10 <	400	20
Min	157.0			3	9	10 <	10 <	200 <	10 <
Mean	201.0			5	13	10 <	10 <	200 <	10 <

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN
Monitoring Station:14 Blackfoot River at USGS station near mouth
Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	665.0	(M)	18.0	8.19	1	6	10	430	300	440
Aug 15	383.0	(M)	20.5	8.15	4	5	10 <	10 <	400	10 <
Sep 13	395.0	(M)	11.2	8.03	1	5	10 <	10 <	200	10 <
Oct 11	369.1	(I)	10.0	7.85	1	5	10 <	10 <	200 <	10 <
Nov 15	564.8	(I)	2.7	7.94	1	10	10	10 <	200 <	10
Dec 13	583.2	(I)	3.0	7.89	1	14	20	10 <	200 <	20

N=	6	6	6	6	6	6	6	6	6
Max	665.0	20.5	8.19	4	14	20	430	400	440
Min	369.1	2.7	7.85	1	5	10 <	10 <	200 <	10 <
Mean	493.4	10.9	8.01	2	8	10 <	72	200 <	78

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:18.5 Bitterroot River at HW93 crossing

Instantaneous Values

Date	Stream- flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)		Total KJL-N Conc. (ug/l as N)		TSIN Conc. (ug/l as N)
Jul 13	780.0	(E)			6	16	60	10	<	200		60
Aug 16	398.0	(E)			14	19	50	10	<	500		50
Sep 13	361.0	(E)			3	13	60	10	<	200		60
Oct 11	451.0	(E)			4	14	50	10	<	200		50
Nov 16	750.0	(E)			2	13	30	10	<	200	<	30
Dec 13	810.0	(E)			4	24	90	10	<	200	<	90
N=	6		0	0	6	6	6	6		6		6
Max	810.0				14	24	90	10	<	500		90
Min	361.0				2	13	30	10	<	200	<	30
Mean	591.7				6	17	57	10	<	200	<	57

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:19 Bitterroot River near mouth

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)		Total KJL-N Conc. (ug/l as N)		TSIN Conc. (ug/l as N)
Jul 13	780.0	(E)	15.8	7.70	4	11	100	10	<	300		100
Aug 16	398.0	(E)	18.0	7.90	6	14	70	10	<	300		70
Sep 13	361.0	(E)	15.8	8.09	5	12	50	10	<	200		50
Oct 11	451.0	(E)	14.2	7.99	5	13	60	10	<	200		60
Nov 16	750.0	(E)	4.1	7.55	2	28	50	10	<	200	<	50
Dec 13	810.0	(E)	3.9	6.75	3	29	70	10	<	200		70
N=	6		6	6	6	6	6	6		6		6
Max	810.0		18.0	8.09	6	29	100	10	<	300		100
Min	361.0		3.9	6.75	2	11	50	10	<	200	<	50
Mean	591.7		12.0	7.66	4	18	67	10	<	200		67

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:26 Flathead River near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	5560.0 (M)	18.2	7.94	1	4	10	10 <	200 <	10
Aug 17	3990.0 (E)	22.9	8.41	2	8	10 <	10 <	200	10 <
Sep 14	3920.0 (M)	18.8	8.13	1	6	10 <	10 <	200	10 <
Oct 12	8490.0 (M)	15.0	7.81	1	7	20	10 <	200	20
Nov 16	11400.0 (M)	6.4	7.53	3	10	10	10 <	200 <	10
Dec 14	9000.0 (E)	3.3	7.70	1	9	30	10 <	200 <	30
N=	6	6	6	6	6	6	6	6	6
Max	11400.0	22.9	8.41	3	10	30	10 <	200	30
Min	3920.0	3.3	7.53	1	4	10 <	10 <	200 <	10 <
Mean	7060.0	14.1	7.92	2	7	12	10 <	200 <	12

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:27.5 Thompson River at USGS station near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	234.0 (M)			4	10	10	10 <	200 <	10
Aug 17	132.0 (M)			4	5	20	10 <	200 <	20
Sep 14	111.0 (M)			5	8	10	10 <	300	10
Oct 12	111.0 (M)			5	7	20	10 <	200 <	20
Nov 17	132.0 (M)			3	12	10 <	10 <	200 <	10 <
Dec 14	217.0 (M)			4	16	30	10 <	200 <	30
N=	6	0	0	6	6	6	6	6	6
Max	234.0			5	16	30	10 <	300	30
Min	111.0			3	5	10 <	10 <	200 <	10 <
Mean	156.2			4	10	15	10 <	200 <	15

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:27.7 Prospect Creek at USGS station near mouth

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	110.0 (M)			4	4	20	10 <	200 <	20
Aug 18	60.0 (M)			6	14	20	10 <	200	20
Sep 15	41.0 (M)			10	7	20	10 <	200 <	20
Oct 13	34.0 (M)			5	7	20	10 <	200 <	20
Nov 17	37.0 (M)			5	10	10 <	10 <	200 <	10 <
Dec 15	75.0 (M)			3	12	50	10 <	200 <	50
N=	6	0	0	6	6	6	6	6	6
Max	110.0			10	14	50	10 <	200	50
Min	34.0			3	4	10 <	10 <	200 <	10 <
Mean	59.5			6	9	22	10 <	200 <	22

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

APPENDIX C.

CLARK FORK BASIN NUTRIENT MONITORING DATA

POINT SOURCE DISCHARGE MONITORING STATIONS

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA

Monitoring Station:00.5 Butte Metro WWTP discharge

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	7.2	(I)	16.7	6.99	3990	3540	50	10800	12900	10850
Aug 15	7.58	(I)	17.9	7.74	3700	3440	1470	6550	8600	8020
Sep 12	9.39	(I)	16.2	6.21	2860	3330	1880	4930	6800	6810
Oct 11	8.02	(I)	16	6.4	3790	3980	620	9090	10500	9710
Nov 14	7.59	(I)	12.9	6.96	3140	3190	260	9340	10900	9600
Dec 12	7.68	(I)	11.4	7.13	3030	4470	240	11500	11900	11740
N=	6		6	6	6	6	6	6	6	6
Max	9.4		17.9	7.74	3990	4470	1880	11500	12900	11740
Min	7.2		11.4	6.21	2860	3190	50	4930	6800	6810
Mean	7.9		15.2	6.91	3418	3658	753	8702	10267	9455

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA

Monitoring Station:06.5 Warm Springs lagoon discharge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 11	0.1 (I)			163	215	350	370	1500	720
Aug 15	0.0 (I)			345	326	20	800	2200	820
Sep 12	0.1 (I)			113	245	100	60	1000	160
Oct 11	0.1 (I)			95	140	240	210	1200	450
Nov 14	0.4 (I)			52	93	140	10 <	2000	140
Dec 12	0.6 (I)			149	271	110	2140	3300	2250
N=	6	0	0	6	6	6	6	6	6
Max	0.6			345	326	350	2140	3300	2250
Min	0.0			52	93	20	10 <	1000	140
Mean	0.2			153	215	160	597	1867	757

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA
Monitoring Station:07.7 Galen WWTP discharge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	0.3 (I)			1290	1470	2280	300	1800	2580
Aug 16	0.1 (I)			3290	3620	4710	1150	4220	5860
Sep 13	0.1 (I)			2510	2800	2420	270	2100	2690
Oct 12	0.1 (I)			4280	4260	11400	100	1200	11500
Nov 15	0.1 (I)			3250	3580	10000	1090	2800	11090
Dec 13	0.1 (I)			3820	4500	8180	370	4300	8550
N=	6	0	0	6	6	6	6	6	6
Max	0.3			4280	4500	11400	1150	4300	11500
Min	0.1			1290	1470	2280	100	1200	2580
Mean	0.1			3073	3372	6498	547	2737	7045

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:09.5 Deer Lodge Lagoon discharge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	3.8 (I)			1340	1530	60	2060	4200	2120
Aug 16	2.5 (I)			1760	1930	90	2120	6100	2210
Sep 13	1.9 (I)			2140	5250	80	3590	8000	3670
Oct 12	1.5 (I)			2530	2700	90	6600	8900	6690
Nov 15	1.5 (I)			2300	2640	120	6850	9800	6970
Dec 13	1.5 (I)			2280	2670	120	7260	9400	7380
N=	6	0	0	6	6	6	6	6	6
Max	3.8			2530	5250	120	7260	9800	7380
Min	1.5			1340	1530	60	2060	4200	2120
Mean	2.1			2058	2787	93	4747	7733	4840

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMA

Monitoring Station:11.6 Drummond Lagoon discharge

Instantaneous Values

Date	Streamflow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	0.1 (E)			639	944	10	40	3400	50
Aug 15	0.1 (I)			1110	1280	10	1450	4600	1460
Sep 13	0.1 (I)			963	1040	40	2350	3800	2390
Oct 11	0.2 (I)			766	956	40	1050	2370	1090
Nov 15	0.2 (I)			275	302	60	10 <	4100	60
Dec 13	0.2 (I)			702	7870	60	3570	4200	3630
N=	6	0	0	6	6	6	6	6	6
Max	0.2			1110	7870	60	3570	4600	3630
Min	0.1			275	302	10	10 <	2370	50
Mean	0.2			743	2065	37	1410	3745	1447

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:17 Missoula WWTP discharge

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 12	11.9	(I)	18.9	7.27	4690	4430	3780	6480	9000	10260
Aug 16	12.3	(I)	20.2	7.93	5300	4820	1180	9430	11700	10610
Sep 13	11.6	(I)	19.5	7.16	4750	4720	7460	2650	4000	10110
Oct 11	10.8	(I)	19.0	7.20	4920	5060	3670	8740	10000	12410
Nov 15	11.2	(I)	15.6	7.24	4930	5390	20	16200	18100	16220
Dec 13	11.2	(I)	14.3	7.35	4930	5330	2430	12500	15000	14930
N=	6		6	6	6	6	6	6	6	6
Max	12.3		20.2	7.93	5300	5390	7460	16200	18100	16220
Min	10.8		14.3	7.16	4690	4430	20	2650	4000	10110
Mean	11.5		17.9	7.36	4920	4958	3090	9333	11300	12423

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

Monitoring Station:21 Stone Container Corporation wastewater discharge

Instantaneous Values

Date	Stream- flow (cfs)		Water Temp. (deg.C)	pH	Ortho P Conc. (ug/l as P)	Total P Conc. (ug/l as P)	NO3+NO2 Conc. (ug/l as N)		Total NH3+ NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	0.0	(I)									
Aug 16	0.0	(I)									
Sep 13	0.0	(I)									
Oct 12	0.0	(I)									
Nov 16	2.8	(I)	3.9	8.06	181	368	10	<	1280	4300	1280
Dec 14	4.4	(I)	4.0	8.00	566	510	30		1240	3600	1270
N=	6		2	2	2	2	2		2	2	2
Max	4.4		4.0	8.06	566	510	30		1280	4300	1280
Min	0.0		3.9	8.00	181	368	10	<	1240	3600	1270
Mean	1.2		4.0	8.03	374	439	15		1260	3950	1275

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:23.5 Alberton lagoon discharge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	0.03 (I)			4060	5110	5890	260	9100	6150
Aug 16	0.01 (I)			4610	5180	830	4210	9600	5040
Sep 14	0.01 (I)			5630	6690	280	10800	14800	11080
Oct 12	0.03 (I)			6210	6410	630	16500	18200	17130
Nov 16	0.03 (I)			5060	5460	1540	15200	18700	16740
Dec 14	0.05 (I)			4950	6850	1540	18000	21500	19540
N=	6	0	0	6	6	6	6	6	6
Max	0.1			6210	6850	5890	18000	21500	19540
Min	0.0			4060	5110	280	260	9100	5040
Mean	0.0			5087	5950	1785	10828	15317	12613

NOTE: Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:24.5 Superior lagoon discharge

Instantaneous Values

Date	Stream-flow (cfs)		Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 13	0.1	(E)			6210	7380	690	15800	22800	16490
Aug 17	0.1	(I)			6880	6920	290	14700	22000	14990
Sep 14	0.1	(I)			5560	6810	310	12300	18600	12610
Oct 12	0.1	(I)			6120	6110	150	17000	20200	17150
Nov 16	0.1	(I)			6220	6450	800	19700	22900	20500
Dec 14	0.1	(I)			5750	9620	110	19600	23900	19710
N=	6		0	0	6	6	6	6	6	6
Max	0.1				6880	9620	800	19700	23900	20500
Min	0.1				5560	6110	110	12300	18600	12610
Mean	0.1				6123	7215	392	16517	21733	16908

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.

CLARK FORK BASIN MONITORING - FY 1989 MONTANA WATER QUALITY BUREAU GARY INGMAN

Monitoring Station:27.6 Thompson Falls lagoon discharge

Instantaneous Values

Date	Stream-flow (cfs)	Water Temp. (deg.C)	pH	Diss.Ortho P (SRP) Conc. (ug/l as P)	Total P Conc. (ug/l as P)	Diss.NO3+NO2 Conc. (ug/l as N)	Diss.NH3+NH4 Conc. (ug/l as N)	Total KJL-N Conc. (ug/l as N)	TSIN Conc. (ug/l as N)
Jul 14	0.2 (I)			1110	2080	400	10	5800	410
Aug 17	0.1 (I)			313.00	1710	10	10 <	5400	10
Sep 15	0.1 (I)			1280	2510	10 <	270	4500	270
Oct 12	0.1 (I)			2530	3430	80	210	5890	290
Nov 17	0.1 (I)			4220	4650	220	4110	7700	4330
Dec 15	0.1 (I)			3510	4570	250	6260	9700	6510
N=	6	0	0	6	6	6	6	6	6
Max	0.2			4220	4650	400	6260	9700	6510
Min	0.1			313	1710	10 <	10 <	4500	10
Mean	0.1			2161	3158	160	1810	6498	1970

NOTE:Estimated streamflows are denoted with an (E) following the value.
Instantaneous streamflows (gaged) are denoted with an (I) following the value.
Mean daily streamflows (USGS) are denoted with an (M) following the value.

Nutrient values less than the analytical detection limit are denoted with a less than sign (<) following the result and are considered to be zero in the data computations.